ANTHROPOLOGISCHE UNTERSUCHUNGEN ZUM ERNÄRUNGSZUSTAND UND ZU ERNÄRUNGSGEWOHNHEITEN LAOTISCHER FLUCHTLINGSKINDER IN THAILÄNDISCHEN FLUCHTLINGSLAGERN UND IN DER BUNDESREPUBLIK DEUTSCHLAND

NUTRITIONAL STATUS AND FEEDING PRACTICES OF LAOTIAN REFUGEE CHILDREN IN THAILAND TRANSIT CAMPS AND IN THE FEDERAL REPUBLIC OF GERMANY

A thesis submitted in partial fulfillment of the requirements for award of a doctoral degree at the department of Biology

in the
Institute of Anthropology
and
Human Biology

and the
Department of Epidemiology
Institute for Social Medicine

of the
Free University of Berlin

Federal Republic of Germany

May 1986

Inaugural-Dissertation zur Erlangung der Doktorwürde im Fachbereich Biologie der Freien Universität Berlin

Institut für Anthropologie
und
Humanbiologie

und der
Arbeitsgruppe Epidemiologie
Institut für Soziale Medizin

der Freien Universität Berlin

Mai 1986

vorgelegt von

PAUNGTHIP BOONPERM

KALASIN, THAILAND

ANTHROPOLOGISCHE UNTERSUCHUNGEN ZUM ERNÄRUNGSZUSTAND UND ZU ERNÄRUNGSGEWOHNHEITEN LAOTISCHER FLÜCHTLINGSKINDER IN THAILÄNDISCHEN FLÜCHTLINGSLAGERN UND IN DER BUNDESREPUBLIK DEUTSCHLAND

NUTRITIONAL STATUS AND FEEDING PRACTICES OF LAOTIAN REFUGEE CHILDREN IN THAILAND TRANSIT CAMPS AND IN THE FEDERAL REPUBLIC OF GERMANY

A thesis submitted in partial fulfillment of the requirements for award of a doctoral degree at the department of Biology

in the
Institute of Anthropology
and
Human Biology

and the
Department of Epidemiology
Institute for Social Medicine

of the
Free University of Berlin

Federal Republic of Germany

May 1986

Inaugural-Dissertation zur Erlangung der Doktorwürde im Fachbereich Biologie der Freien Universität Berlin

Institut für Anthropologie
und
Humanbiologie

und der
Arbeitsgruppe Epidemiologie
Institut für Soziale Medizin

der Freien Universität Berlin

Mai 1986

vorgelegt von

PAUNGTHIP BOONPERM

KALASIN, THAILAND

Digitized by the Internet Archive
in 2026

https://archive.org/details/IA41549614_0060

1. Referent: Prof. Dr. rer. nat. Carsten Niemitz

2. Referent: Prof. Dr. med. Frank-Peter Schelp

Prüfungsdatum: 31. Juli 1986

Gedruckt mit Genehmigung des Fachbereichs Biologie
der Freien Universität Berlin

Gedruckt mit Unterstützung des
Deutschen Akademischen Austauschdienstes

TABLE OF CONTENTS

	Page
Table of Contents	i
List of Figures	vii
List of Tables	ix
SUMMARY	1
1. INTRODUCTION	3
2. BACKGROUND	3
2.1 PHYSICAL & CULTURAL BACKGROUND ON LAOS	3
2.1.1 GEOGRAPHY AND POPULATION	3
2.1.2 CLIMATE	4
2.1.3 LANGUAGE	4
2.1.4 PEOPLE	4
2.1.4.1 LOWLAND LAO	4
2.1.4.2 MON-KHMER GROUP	5
2.1.4.3 TAI GROUP	5
2.1.4.4 OTHER GROUPS	5
2.1.5 CULTURE	5
2.1.6 EDUCATION	6
2.1.7 HEALTH	7
2.1.8 DIET	7
2.2 HISTORICAL BACKGROUND	7
2.2.1 POLITICAL HISTORY	7
2.2.2 REFUGEE MIGRATION TO THAILAND	8
2.2.3 REFUGEE CAMPS IN THAILAND	9
2.2.4 REFUGEE EMIGRATION TO THIRD COUNTRIES	11
2.2.5 REFUGEE IMMIGRATION TO THE FRG	11

Page

2.2.6 POPULATION OF LAOTIAN REFUGEES IN THE FRG 12

2.2.7 HEALTH STATUS OF INDOCHINESE REFUGEES IN THE FRG 12

3. MATERIALS AND METHODS 14

3.1 STUDY POPULATIONS 14

3.1.1 THAILAND 14

3.1.2 FEDERAL REPUBLIC OF GERMANY 14

3.2 LOCATING SUBJECTS AND STUDY SIZE 15

3.2.1 THAILAND 15

3.2.2 FRG 15

3.3 ANTHROPOMETRIC MEASUREMENTS 16

3.3.1 THAILAND 16

3.3.2 FRG 16

3.3.2.1 WEIGHT 16

3.3.2.2 LENGTH AND HEIGHT 16

3.3.2.3 ARM CIRCUMFERENCE 17

3.3.2.4 TRICEPS AND SUBSCAPULAR - SKINFOLD THICKNESS 17

3.4 INTERVIEW DATA 17

3.4.1 AGE AND FEEDING HISTORY 17

3.4.2 SOCIO-ECONOMIC DATA 18

3.4.3 HEALTH STATUS AND OTHER FACTORS 18

3.4.4 MATERNAL HEALTH KNOWLEDGE 18

3.5 CALCULATIONS AND DATA ANALYSIS 19

3.5.1 ANTHROPOMETRIC INDICES (S.D.-scores) 19

3.5.1.1 WEIGHT-FOR-AGE (W/A) 19

3.5.1.2 HEIGHT-FOR-AGE (H/A) 21

3.5.1.3 WEIGHT-FOR-HEIGHT (W/H) 21

Page

3.5.2 ARM MUSCLE AND ARM FAT AREAS 22

3.5.3 SKINFOLD THICKNESS 22

3.5.4 CORRELATION 22

3.5.5 FEEDING HISTORIES, BIRTHWEIGHT, INCOME 23

3.5.6 HEALTH KNOWLEDGE 23

4. RESULTS 24

4.1 ANTHROPOMETRIC INDICES- BASED ON WEIGHT AND HEIGHT 24

4.1.1 THAILAND vs. FRG vs. REFERENCE STANDARDS 24

4.1.2 S.D.-SCORES (W/A, H/A, W/H) 24

4.1.2.1 S.D.-SCORES BY SEX: GIRLS vs. BOYS 25

4.1.2.2 S.D.-SCORES BY AGE GROUP 26

4.1.2.3 S.D.-SCORES BY AGE GROUP BY SEX: GIRLS vs. GIRLS 26

4.1.2.4 S.D.-SCORES BY AGE GROUP BY SEX: BOYS vs. BOYS 27

4.1.3 WASTING AND STUNTING 27

4.1.4 ANTHROPOMETRIC INDICATORS OF LAO-BORNS AND FRG-BORNS 28

4.2 MID-UPPER-ARM CIRCUMFERENCE 28

4.3 TRICEPS AND SUBSCAPULAR SKINFOLD THICKNESS 29

4.4 ARM MUSCLE AREA 30

4.5 ARM FAT AREA 30

4.6 RELATIONSHIP BETWEEN ANTHROPOMETRIC INDICES 31

4.7 FEEDING PATTERNS IN THE FRG 31

4.8 MILK FEEDING 32

4.9 DMFT (DECAYED, MISSING, FILLED TEETH) 33

4.10 SOCIO-ECONOMIC DATA 33

4.10.1 FAMILY TYPE AND CHILD-CARE 33

Page

4.10.2 PARENTAL AGE, EDUCATION, RESIDENCE HISTORY 34

4.10.3 PARENTAL INCOME AND EMPLOYMENT 34

4.11 HEALTH STATUS AND BIRTHWEIGHT 35

4.12 HEALTH KNOWLEDGE 35

5. DISCUSSION 37

5.1 NUTRITIONAL STATUS OF LAOTIAN REFUGEES 37

5.1.1 PREVIOUS STUDIES 37

5.1.2 SAMPLE SELECTION 37

5.1.3 COMPARISON OF THAILAND AND FRG STUDY GROUPS 38

5.1.4 WASTING AND STUNTING 39

5.1.5 SKINFOLD THICKNESS 39

5.1.6 ARM MUSCLE AREA AND ARM FAT AREA 41

5.1.7 GIRLS vs. BOYS 41

5.2 FEEDING PATTERNS 41

5.2.1 BREAST FEEDING 41

5.2.2 WEANING 42

5.3 FACTORS INFLUENCING NUTRITIONAL STATUS 42

5.3.1 MIGRATION 42

5.3.2 SOCIO-ECONOMIC STATUS 43

5.3.3 ENVIRONMENTAL FACTORS 44

5.3.4 GENETIC FACTORS 44

5.3.5 INFANT FEEDING PRACTICES 46

5.3.6 MATERNAL FACTORS 47

5.3.7 INFECTION 47

5.3.8 SEASONALITY 48

5.3.9 PSYCHOLOGICAL STRESS 49

Page

5.4 ANTHROPOMETRY 49

5.4.1 INDICATORS OF NUTRITIONAL STATUS 49

5.4.2 HISTORY 50

5.4.3 TECHNIQUE 50

5.4.4 LIMITATIONS 51

5.4.5 STANDARDS OF REFERENCE 52

5.5 ANTHROPOMETRIC INDICATORS OF MALNUTRITION 53

5.5.1 WEIGHT-FOR-AGE (W/A) 53

5.5.1.1 GOMEZ CLASSIFICATIONS 54

5.5.1.2 S.D.-SCORE AND NCHS STANDARDS 54

5.5.1.3 LIMITATIONS 55

5.5.2 HEIGHT-FOR-AGE (H/A) 55

5.5.2.1 GOMEZ CLASSIFICATION 56

5.5.2.2 S.D.-SCORE 56

5.5.2.3 STUNTING 56

5.5.3 WEIGHT-FOR-HEIGHT (W/H) 57

5.5.3.1 S.D.-SCORE 57

5.5.3.2 PERCENT OF MEDIAN 57

5.5.3.3 WASTING 57

5.5.4 MID-UPPER-ARM CIRCUMFERENCE (MUAC) 58

5.5.5 SKINFOLD THICKNESS 58

5.5.6 ARM MUSCLE AREA AND ARM FAT AREA 59

5.6 ANTHROPOMETRY AS INDICATORS OF SOCIO-ECONOMIC WELL-BEING 59

6. FIGURES 61

7. TABLES 80

8. BIBLIOGRAPHY 92

9. ACKNOWLEDGEMENT 105

Page

10. APPENDICES 106

I Health Knowlege Survey Form (in Lao) 107

II Health Knowledge Survey Form (English translation) 108

III Curriculum Vitae 109

LIST OF FIGURES

		Page
Fig. 1	Map of Laos, Political Boundaries	61
Fig. 2	Map of Laos, Ethnic Groups	62
Fig. 3	Map of Southeast Asia, Ethnic Groups	63
Fig. 4	Indochinese Refugee Arrivals in Thailand by Group and by Year	64
Fig. 5	Map of the Federal Republic of Germany	65
Fig. 6	Weight measurement	66
Fig. 7	Length measurement	66
Fig. 8	Arm circumference measurement	67
	8a Identifying the mid-point between acromion and olecranon	67
	8b Mid-upper arm circumference measurement	67
Fig. 9	Triceps skinfold measurement	68
Fig. 10	Subscapular skinfold measurement	69
Fig. 11	Weight by Age, of Females	70
Fig. 11	Weight by Age, of Males	70
Fig. 12	Height by Age, of Females	71
Fig. 12	Height by Age, of Males	71
Fig. 13	Frequency Distribution of Weight-for-Age	72
Fig. 13	Frequency Distribution of Height-for-Age	72
Fig. 13	Frequency Distribution of Weight-for-Height	73
Fig. 14	Mean S.D.-scores of Anthropometric Indices, by Sex	74
Fig. 15	Mean of S.D.-scores by age: sex combinded	75
	15a subjects in the Thailand camps	75
	15b subjects in the FRG	75
Fig. 16	Median Mid-upper Arm Circumference	76
	16a Girls	76
	16b Boys	76

		Page
Fig. 17	Triceps-skinfold Thickness	77
	17a Girls	77
	17b Boys	77
Fig. 18	Subscapular-skinfold Thickness	78
	18a Girls	78
	18b Boys	78
Fig. 19	Median Arm Muscle Area, by Age-group, and by Sex	79
Fig. 20	Median Arm Fat Area, by Age-group, and by Sex	79

LIST OF TABLES

		Page
Table 1a.	Mean Anthropometric Measurements by Age-group, Girls Only.	80
Table 1b.	Mean Anthropometric Measurements by Age-group, Boys Only.	81
Table 2a.	Mean S.D.-score of Anthropometric Indices, by Age, Girls Only	82
Table 2b.	Mean S.D.-score of Anthropometric Indices, by Age, Boys Only	83
Table 3.	Wasting and Stunting, by Age	84
Table 4.	Correlation and Regression among Anthropometric Measurements	85
Table 5.	Feeding History and Correlation with Anthropometric Indices, by Place of Birth	86
Table 6.	Milk Feeding Practices	87
Table 7.	Distribution of DMFT of FRG-Laos and German (Storman) preschool children by age	88
Table 8.	Summary of Health, Social, and Economic Variables	89
Table 9.	Reported Occupations of Mothers and Fathers	90
Table 10.	Distribution of "correct" and "do not know " answers in each question.	91

SUMMARY

Anthropometric assessments of lowland Laotian refugee children were performed in two transit camps in Thailand in 1981 and in the Federal Republic of Germany (FRG) in 1982. Of 315 subjects aged 2 to 60 months in the Thailand camps, 30 (9.5%) were wasted (≤2 S.D. below reference median weight-for-height [W/H] and 87 (27.6%) were stunted (≤2 S.D. below reference median height-for-age [H/A]). Of 102 lowland Laotian refugee children aged 3 to 72 months living in the FRG, 4 (3.9%) were wasted and 7 (6.9%) were stunted.

Anthropometric indices for weight-for-age (W/A), H/A, and W/H were significantly lower in study subjects in the Thailand camps than in the FRG ($p<.001$): For W/A the mean S.D.-score in Thailand was -1.35 and in the FRG was -0.63. H/A in Thailand was -1.38 and in the FRG was -0.60. W/H in Thailand was -0.67 and in the FRG was -0.29.

Severe depletion of energy and protein reserves was demonstrated more in the subjects in Thailand than in the subjects in the FRG. Mid-upper-arm circumference (MUAC), triceps and subscapular skinfold thicknesses, and cross-sectional areas of arm muscle and arm fat in the subjects in Thailand were less than or about equal to the 10th percentile of reference populations, compared to subjects in the FRG with measurements between the 10th and 50th percentiles.

Feeding histories obtained for subjects studied in the FRG showed that 49 refugee children born in the FRG were weaned earlier (mean weaning age 9 months) than 35 children born in Laos (mean 18 months, $p<.001$). FRG-born subjects received supplementary foods at significantly earlier ages than Laos-born subjects in the FRG ($p<.001$) for juices (4 months v. 10 months), vegetables (5 v. 11 months), fruits (9 v. 13 months), and table food (10 v. 21 months). In the FRG, exclusive breast-feeding was reported for 6% (3/51) of FRG-born refugees and for 45% (15/33) of Laos-born subjects. Feeding exclusively cow's milk or formula was reported for 39% (20/51) of the FRG-born subjects and for 21% (7/33) of the Laos-born. Earlier feeding of various supplementary foods was significantly associated ($p<.01$) with higher scores on indices for W/A, W/H, and triceps and subscapular skinfold thicknesses. Height for age (H/A) did not correlate with feeding practice.

Although the study subjects in Thailand camps and in the FRG were not from a single cohort, the findings suggest an improvement in the nutritional status of Laotian refugees after migration to the FRG, and quite significant changes in the way refugee parents feed their children born in the FRG compared to the way they fed children born before migration.

There was no significant relationship between the accuracy of knowledge (KS) of the laotian mothers and their education, age, duration of residence in the FRG nor the S.D.-scores of their children. Hence the knowledge and beliefs in health and nutrition were not reflected in practice. The average of % corrected answers was 35% with range from 90% to 15%. The subjects about which mothers tended to answer correctly concerned the health effects of excessive alcohol, smoking and sweets. The subjects about which mothers tended to answer incorrectly were in the areas of the nutritional value and health effects of various foods.

This finding demonstrated, among this ethnic group, stunting is more of a nutritional problem than wasting and dental caries is a serious health problem. It indicated major changes in feeding practice after migration and that earlier supplementary was significantly associated with improvement of most anthropometric indicators, except S.D.-score H/A. It also demonstrated the main types of nutritional misbeliefs among this ethnic group. It has implication for further nutrition education, especially for those institutional catering for this cultural group.

1. INTRODUCTION

Between 1975 and 1981, a total of 1,471 Laotian refugees resettled in the Federal Republic of Germany (FRG), as a result of the large mass exodus into Thailand in the late 1970's in the aftermath of the wars in Indochina (Statistiches Bundessamt, 1983). Mass migrations such as this usually cause major changes in social and cultural practices, with consequent effects on health and physical status.

In order to observe the effect of this migration on lowland Laotian refugees, surveys of nutritional status were done among this population in both transit camps in Thailand and in the FRG. In addition, surveys of their feeding patterns and health knowledge were conducted in the FRG. Major changes in feeding patterns were observed, reflecting a partial adaptation to the very different society and culture that these refugees found in central Europe.

The uses, interpretation, and limitations of anthropometry in assessing nutritional status are reviewed and discussed, along with the other factors that affect the physical well-being of migrants.

2. BACKGROUND

2.1 PHYSICAL & CULTURAL BACKGROUND ON LAOS

2.1.1 GEOGRAPHY AND POPULATION

Laos is a landlocked country in the center of Southeast Asia. It borders China to the north, Vietnam to the east, Kampuchea (Cambodia) to the south, Thailand to the west, and Burma to the northwest (Fig. 1). Known during the period of this research as the Laos People's Democratic Republic, it was formerly known as the Kingdom of Laos.

Laos encompasses 236,725 square kilometers (91,400 square miles) and an estimated population (in 1979) of 3,520,000 people (The Times, 1983). The greatest north-south distance is 1130 km (700 miles) and greatest east-west distance is 445 km (275 miles). The population density is 15 persons per square km (38 per square mile), and is chiefly concentrated in valleys of the Mekong River basin and tributaries (Roberts, 1966).

The northern three-fifths of the country is mostly rugged mountain terrain, except for the large Plain of Jars. The southern two-fifths of the country is shaped as a panhandle, bounded on the east by the high Annamite Chain and on the west by the Mekong River. Between these two natural boundaries of the southern panhandle lies the fertile Bolovens Plateau (Roberts, 1966).

2.1.2 CLIMATE

The period of monsoon rains is May through October, while it is dry from November through April. Most areas receive at least 150 cm (60 inches) of rain per year.

2.1.3 LANGUAGE

The official language, Laotian, used by the lowland population studied in this research, is a tonal language in the Thai linguistic family. Other languages spoken by numerous small ethnic groups are Mon-Khmer of the Austroasiatic linguistic family, and Meo-Yao and Tibeto-Burman of the Sino-Tibetan linguistic family. A small minority of educated persons and immigrants speak French, English, Vietnamese, Chinese, Thai or Indian.

2.1.4 PEOPLE

2.1.4.1 LOWLAND LAO

The Laotian population is composed of several different ethnic groups. Ethnic Lao are the largest group, comprising about 45% to 50% of the population. They are also called Lowland Lao because they live in flatter lowland areas along the Mekong river and its tributaries (Fig. 2). Lowland Lao control the economic and political power of the country.

The lowland Lao, as well as the Northeastern Thai, are believed to be the descendents of "The people of the South," known as the Nan Chao, Payi, and Huans, who formerly lived in the Sichuan province of China in valleys between the Huang Ho river and Chang Jiang (Yang-Tse) river (Jumsai,

1967). It is believed they were driven southwards along the Mekong river by an attack from the Chinese Emperor Kublai Khan. This splited them into two groups, each occupying one side of the Mekong river, which today separates Laos from northeastern Thailand (formerly Siam) (Fig.3). Although differences exist, the Lowland Lao and the Northeastern Thai have a similar dialect, religion, and culture (Halpern, 1964a).

2.1.4.2 MON-KHMER GROUP

The Mon-Kmer group, also referred to variously as the Kha, Lao-Thung, and Lao-Theng, are comprised of numerous hilltribes which together constitute about 20% to 30% of the population. They live on scattered mountain slopes throughout the country and speak an Austroasiatic language similar to the Khmer language of Cambodia (Kampuchea).

2.1.4.3 TAI GROUP

The Tais are tribal groups (Tai Dom, Tai Khao, Tai Daeng, Tai Neau, Phou Tai, etc.) of the Thai linguistic family which live in upland river valleys and plateaus. Together, they comprise about 10% to 20% of the population.

2.1.4.4 OTHER GROUPS

Two other hill tribes, which each comprise about 2% to 5% of the population, are the Meo-Yao (often known as Hmong), and the Tibeto-Burman. Both tribes are part of the Sino-tibetan language group (Lebar, 1960, National Geographic Society, 1971).

2.1.5 CULTURE

Although animism and confucianism are practised among semi-nomadic hill tribe groups, the majority of Lowland Lao are Buddhist, following the Thevarada branch of Buddhism with origins in India. Consequently, Buddhist practices and beliefs imbue their cultural life. The taking of life is discouraged. One's situation and circumstances in life are accepted fatalistically.

Respect for seniority and deference to one's elders are strong, and are reflected in customs of addressing people, in which the person of lower rank and status initiatates the formal greeting and avoids standing higher than a superior. The head is considered sacred, and it is insulting to touch or tap someone's head. In contrast, the feet are considered profane, and showing one's soles or pointing with one's feet is rude.

Differences in sex roles are prominent. Women are expected to care for the family, cook, rear children, and handle financial matters. Men are usually the head of the family, and make the decisions. Lao people are modest. Expressing physical affection between the sexes in public is impolite. Girls are taught to be careful in keeping their body covered. Dressing and undressing is done in private.

Laotians usually welcome guests by offering them something to drink without asking. If guests arrive at the time of a meal, they are automatically welcome and there is always food.

2.1.6 EDUCATION

Most of the Laotian population in the mid-1970s were illiterate. In 1968, the literacy rate, defined as the fourth grade reading level among men between fourteen and forty five years was 50 to 60%. It was only 25% among women between fourteen and thirty five (Lebar, 1960). For the urban elites, the systen of education until 1975 was patterned on the French model. Primary school lasted 6 years, followed by the collège for 3 years, and then either the lycée or various professional schools, which included those for military officers, lawyers, teachers, civil servants, agriculturalists, and livestock breeders. The lycée awarded the "baccalaureat" degree, which was necessary for study elsewhere. There were no universities. Medical students would attend faculties of medicine in Phnom Penh, Hanoi, or Bangkok to complete their medical training (Lebar, 1960).

2.1.7 HEALTH

The most recent data available on the health situation in Laos is from 1966 (Roberts, 1966). Beri beri and pellagra were common nuritional deficiency disorders. Malaria was a major problem, found in all part of the country. Plasmodium falciparum and P vivax accounted for 94% of malaria infections. Measles, whooping cough, chicken pox, mumps, dental caries and intestinal helminthic infections, were widespread. Among school age children, more than 70% were infected with one or more types of parasites. Round worm, tape worm, hook worm and strongyloides are common. Liver flukes are frequent due to the habit of eating raw fresh water fish and snails (Lebar, 1960).

2.1.8 DIET

Glutinous rice is the staple food of lowland Lao, and accounts for 90% of the daily diet. Dried fish and fermented fish are the main source of protein for poor families, while prosperous families may have side dishes of pork, chicken, and beef. Among hilltribes, maize (corn) is an important staple and protein source.

Dairy products are uncommon; milk is not usually in the diet of pregnant women or weaned children. Lactose intolerance is frequent above the age of 4.

2.2 HISTORICAL BACKGROUND

2.2.1 POLITICAL HISTORY

The Laotian Kingdom of Lan Xang was first established in the mid-14th century, and encompassed all of present-day Laos and much of northern and eastern Thailand. This kingdom split into three rival states in 1697. Between 1885 and 1893 France conquered the region, which then became part of French Indochina. Laos achieved political independence in 1953, around the time of the defeat of French colonialism in Southeast Asia.

The first national election took place in 1955, which marked the beginning of a 20-year struggle between various factions from

royalists on the right to Pathet Lao communists on the left. In 1975, the Pathet Lao insurgents prevailed with the support of the recently victorious Viet Cong and North Vietnamese forces in Vietnam. A Leninist "Laos People's Democratic Republic" was instituted, with significant influence exerted by the communist government of Vietnam.

2.2.2 REFUGEE MIGRATION TO THAILAND

Many Laotians--educated intellectuals, businessmen, former civil servants, peasants, and hilltribesmen--fled subsequent political instability, persecution, and economic hardship under the new regime in a mass migration into Thailand. The major means of escape was to wade, swim, or ride across the Mekong River, which demarcates more than half the border between Laos and Thailand.

The first major influx of refugees from the Indochinese countries into Thailand occurred in 1975, during which 54,854 Laotians, 17,038 Kampucheans (Cambodians), and 4,446 Vietnamese arrived in Thailand (UNHCR, 1985). From 1975 through the end of 1981, Thailand had received a total of 575,328 Indochinese refugees, of which 47.1% (270,845) were Laotians, 37.5% (215,557) were Kampucheans, and 15.4% (88,926) were Vietnamese.

The Laotian refugees are divided into two groups. Hilltribe refugees, mostly of the Hmong tribe, predominated in the first wave of emigration in 1975, primarily as a result of political persecution by the Pathet Lao because of Hmong cooperation with Americans during the Vietnam War (see Fig.4) Lowland Lao refugees predominated during the second wave of emigration that started in 1978. Economic hardship was the most frequently cited reason for emigration during this period. Of the 270,845 refugees from Laos between 1975 and 1981, lowland Laotians constituted 61% (163,934), and hilltribe refugees the remaining 39% (106,911).

Laotian refugee emigration continued after the time when the studies reported here were performed in 1981 and 1982. As of the end of 1985, there was a cumulative total since 1975 of 652,397 Indochinese refugees

arriving in Thailand. These included 315,885 (48%) from Laos, of which 199,668 (63%) were lowland Lao and 116,217 (37%) were hilltribe members.

Data on births to Laotian refugees in camps in Thailand are available since 1980 (UNHCR, 1985). In that year, there were 1,033 lowland infants and 1,733 hilltribe infants born in camps. In 1981, there were 1,166 lowland and 2,300 hilltribe births. From 1980 through 1985, a total of 6,069 lowland and 15,528 hilltribe infants were born in Thailand refugee camps.

2.2.3 REFUGEE CAMPS IN THAILAND

Eight camps in Thailand, named after the nearest town or provincial capital, were created along the border with Laos for Laotian refugees. Lowland Lao were assigned to three of these camps: Ubon, Nong Khai, and Ban Napho. Ubon camp opened in June 1975, had a mid-year population in 1981 of 15,066, and closed in December 1982 (it reopened in 1984 as a voluntary resettlement center) (UNHCR, 1984). Ubon camp, in the easternmost corner of Thailand, housed mainly lowland refugees fleeing from the southern provinces of Laos. Although most Ubon Camp residents were former town dwellers, including government officials, merchants and other middle class professionals, a significant number of its refugees were formerly rice farmers or villagers from rural areas.

Nong Khai camp opened in March 1976, had a mid-year population in 1981 of 17,632, and closed in September 1982. The Nong Khai Camp contained predominantly lowland refugees from the nearby Laotian capital city of Vientiane and its surrounding areas. Most of the refugees there were civil servants or military officials of the former royalist government (UNHCR, 1983). Ban Napho camp opened in 1977, had a mid-year population in 1983 of 19,022, and remains open.

Hilltribe Laotians were assigned to five camps: Chiang Khong, Chiang Kham, Sob Tuang, Ban Nam Yao, and Ban Vinai. Among hilltribe refugees, the Hmong formed the largest group, and most of them were settled in Ban Vinai Camp in Loei Province of Thailand.

Two transit camps were established to process refugees enroute to resettlement in third countries. A transit camp at Phanat Nikhom, about 100 km east of Bangkok, was opened in 1977, and had an average population in 1981 of 20,410 persons. Another transit camp, in the Lumpini district of Bangkok, was actually a holding center to house refugees awaiting final arrangements and air transportation out of Thailand. In these transit camps there was a very frequent turnover of refugees arriving from more permanent refugee camps in Thailand and of refugees departing for final resettlement in third countries.

The camps in Thailand for Laotians provided varying degrees of food, water, shelter, medical care and other health social services, sanitation, education, and cottage industry training. Medical services provided included surgery, immunization, contraception, and treatment of endemic diseases such as tuberculosis, leprosy, malaria, venereal diseases.

Detailed vital statistics and disease surveillance data is available from some of the refugee camps housing lowland Lao in Thailand (UNHCR, 1984). In 1981, the crude birth rate was 27.0 (per 1,000 population) in Ubon camp, 20.6 in Nong Khai camp, not available for Ban Napho camp, and 52.0 in Phanat Nikhom (which held refugees of all Indochinese countries (UNHCR, 1984). The crude death rate in 1981 was 1.5 (per 1,000) in Ubon camp, 1.7 in Nong Khai, and 2.2 in Phanat Nikhom transit camp. In 1981, neonatal mortality was 12.3 (per 1,000) in Ubon camp, 5.2 in Nong Khai camp, and 2.2 in Phanat Nikhom transit camp. Infant mortality in 1981 was 19.6 (per 1,000) in Ubon camp, 13.1 in Nong Khai camp, and 19.6 in Phanat Nikhom transit camp.

In 1981, the leading categories for hospitalization in all Thailand refugee camps were 1) infective and parasitic diseases (ICD 001-139), accounting for 23.5% of the total admissions; 2) deliveries, pregnancy, childbirth, and the puerperium (ICD 630-679) for 22.3% of admissions; disorders of the respiratory system (ICD 460-519) for 15.5% of admissions; and ICD 780-799.8 (all other symptoms and ill-defined conditions) for 15.7% of admissions (UNHCR,1981). The

leading causes of death, in rank order for all age groups, were 1) unknown, 2) bronchopneumonia, 3) prematurity, 4) sepsis/septicemia, 5) cardio-pulmonary arrest 6) accidents, poisoning, and violence, 7) cancer, 8) tuberculosis, 9) malaria, and 10) aseptic meningitis.

In 1984, the incidence of low birth weight (<2.5 kg) was 8.3% (292/3499) among all camps, 12.5% (61/489) in Ban Napho, and 10.0% (46/466) in Phanat Nikhom (UNHCR, 1984).

2.2.4 REFUGEE EMIGRATION TO THIRD COUNTRIES

After periods of a few months to a few years in the Thailand refugee camps, the majority of the Laotian refugees have been allowed to leave the refugee camps for permanent resettlement in third countries. Cumulative resettlement of lowland Laotians from 1975 through 1985 totalled 145,106, which represents about 73% of the total of 199,668 arrivals from Laos during the same period (UNHCR, 1985). In addition, 68,792 hilltribe refugees resettled to third countries in this period, which is 59% of their total arrivals (116,217) into Thailand.

The 145,106 Lowland Laotians were resettled in over 17 different countries. There were 93,361 (64%) to the United States, 24,442 (17%) to France, 12,186 (8%) to Canada, 6,384 (4%) to Australia, 2,503 (2%) to China, 1,623 (1%) to the FRG, and 4,607 (3%) to over 14 other countries.

The 68,792 hilltribe Laotians were resettled in 10 different countries. The United States accepted 59,184 (86%). The FRG received 21 (0.03%).

Surveys of refugees arriving in the United States indicated that tuberculosis, stress, and intestinal parasites were the most common health problems to be treated in arriving refugees (CDC, 1979a).

2.2.5 REFUGEE IMMIGRATION TO THE FRG

Refugees were selected for immigration to most countries of asylum, including the FRG, by representatives of those countries who interviewed them in refugee camps in

Thailand. Medical screening, travel, and other logistical arrangements for their migration were handled by the Intergovernmental Committee for European Migration (ICEM), later known as the Intergovernmental Committee for Migration (ICM).

The housing, social, economic and medical needs of Indochinese refugees arriving in the FRG were taken care of by both governmental agencies and private voluntary agencies, including the Deutsche Caritas Verband (German Charity Union), the Deutsches Rotes Kreuz (German Red Cross), and the Diakonisches Werk (Deacon's Action). A 10- to 12-months course in the German language was provided upon arrival.

2.2.6 POPULATION OF LAOTIAN REFUGEES IN THE FRG

Laotians comprised 7.7% (1,471) of the total of 19,077 Indochinese refugees who resettled in the FRG from January 1975 to September 1981 (Statistisches Bundesamt, 1983). This data on Laotian emigration is consistent with UNHCR figures cited in section 2.2.4, which indicate that by the end of 1985 this total had climbed to 1,623 lowland and 21 hilltribe Laotians resettled in the FRG.

At the time of the studies reported here, about 33.0% (486) of the 1,471 Laotians lived in North Rhine Westphalia, 30.5% (449) in Baden Wurttemberg, 10.5% (155) in Hesse, 8.6% (126) in Bavaria, 5.0% (74) in West Berlin, 4.7% (69) in Rheinland Palatinate, 3.8% (56) in Schleswig-Holstein, 1.6% (24) in Hamburg, 1.1% (16) in Lower Saxony, 0.6% (9) in Saarland, and 0.5% (7) in Bremen.

2.2.7 HEALTH STATUS OF INDOCHINESE REFUGEES IN THE FRG

There was very few studies on the health status of these Indochinese refugees in the FRG. Feldmeier (1981) reported the health examinations upon arrival of 492 Indochinese refugees in Hamburg (447 Vietnamese, 45 Laotians). 51.2% (252/492) suffered from caries, 21.1% (104/492), from skin diseases, 4.9% (24/492), from internal diseases and 3.5% (17/492) from other diseases.

46.5% (20/43) Laotians and 24.9% (106/425) Vietnameses were anaemic. In general, the Laotians were infected with parasitic diseases more than the Vietnameses. 44.2% Laotians were infected with Ophisthorchiasis, none from the Vietnameses was infected. 41.9% Laotians, 43.6% Vietnameses were infected with Ascaris. 34.9% Laotians and 4.1% Vietnameses were infected with Trichuris.

3. MATERIALS AND METHODS

3.1 STUDY POPULATIONS

This study was restricted to lowland Lao because the investigator was fluent in their language.

3.1.1 THAILAND

The target population in Thailand consisted of all lowland Lao refugee children from ages 2 to 60 months who were living in the refugee holding camps in Panat Nikhom district, Chonburi province, and in Lumpini district, Bangkok.

3.1.2 FEDERAL REPUBLIC OF GERMANY

The target population in the FRG consisted of all lowland Laotian refugee children living anywhere in the Federal Republic of Germany (FRG). Although estimates of the total number of Laotian refugees in the FRG are consistent between data from the FRG government and of the United Nations High Commissioner for Refugees (UNHCR), there is a discrepancy between these two sources in the proportion which are lowlanders.

According to FRG Government figures, refugees from Laos comprise 7.7% (1,471) of the total of 19,077 Indochinese refugees who resettled in the FRG between January 1975 and September 1981 (Statistisches Bundesamt, 1983). Of these 1,471 Laotians, 217 (15%) were listed as children under age six. About 68% (1005/1471) of the total Laotians in the FRG are classified as lowlanders, while the remainder are made up of various ethnic groups (Hmong, Mien, You-thin, Kha, Chinese, Vietnamese).

The United Nations High Commission for Refugees reports that the number of Laotian refugees who departed Thailand for resettlement in the FRG between 1975 and 1985 was 1,644, of which 1,623 (99%) were lowland Lao and 21 were hilltribe Lao (UNHCR, 1985).

3.2 LOCATING SUBJECTS AND STUDY SIZE

3.2.1 THAILAND

The two transit camps in Thailand were visited in June 1981. Subjects were obtained for the survey by requesting the Laotian camp leaders to bring all eligible children and their mothers to the examination sites. A total of 315 subjects were included. Although the selection of children was non-random, the majority of lowland Lao children in the camps were included in the sample. These transit camps have a very high turnover of refugees arriving from long-stay camps in Thailand and refugees departing for final resettlement in many countries around the world.

3.2.2 FRG

In the FRG, membership information provided by the Association of Laotians in the FRG (Verein der Laoten in der Bundesrepublik Deutschland) was used to obtain the names and addresses of resettled lowland Laotian families. They lived in 16 different cities: Minden, Detmold, LÜnen, Castrop-Rauxel, Herten, Iserlohn, Neuss, Kaarst-Korschen, Hilden, Köln, Mannheim, Schwetzingen, Karlsdorf, Ketsch, Heidelberg, and Hornberg (Fig. 5).

In August and September 1982, we found and studied these families, and from them identified other lowland Lao families with children under age six, who were also studied. A total of 75 families containing 108 children under 6 were identified. Of these, 2 families (3%) each with 1 child refused to participate, leaving a final study population of 73 families with 106 children. This probably represented nearly all of the target population in the FRG. None of the 315 subjects studied in the Thailand transit camps turned up in the FRG survey.

The FRG government (Statistisches Bundesamt 1983) reports a total of 217 Laotian refugee children under age six, but this number includes the ethnic groups (Hmong, Mien, You-thin, Kha, Chinese, Vietnamese) not targeted in this study. Applying the proportion of 68% that FRG

government data indicates is the proportion of lowlanders of all ages (1005) among the total Laotian population (1471), there would be an estimated total of 148 lowlander children (0.68 x 217) less than six years old in the FRG. Thus, this study included about 72% (106/148) of the target population.

3.3 ANTHROPOMETRIC MEASUREMENTS

3.3.1 THAILAND

For each subject in the Thailand transit camps, we ascertained the age, weight, height, arm circumference, and subscapular and triceps skinfold thickness by standard methods (Tanner, 1962).

3.3.2 FRG

3.3.2.1 WEIGHT

In the FRG, the weight, height, and skinfold thickness were measured for each of the 106 study subjects using standard methods. Body weight was measured to the nearest 0.1 kg using a beam balance (SECA, Vogel & Halke, Hamburg, FRG) (Fig. 6). The weight of children less than 12 months of age was determined by subtraction of the mother's weight alone from the combined weight of mother and child. Subjects were weighed without footwear and wearing only light indoor clothing.

3.3.2.2 LENGTH AND HEIGHT

The supine length of children up to 36 months of age was measured by three persons using a measuring tape fixed to a horizontal flat surface, itself fixed to a vertical board where the child's head was brought into contact with the fixed headboard. A second person held the infant's feet, knees, and hips completely extended, toes pointing directly upward. A third person brought the movable footboard against the infant's heels and the reading was taken (Fig.6). The standing height of children older than 36 months was measured to the nearest 0.5 cm using the headstop and sliding scale on the vertical post of the balance.

3.3.2.3 ARM CIRCUMFERENCE

The upper left arm circumference was measured in centimeters at the point midway between the tip of the acromion and the olecranon process (Fig. 8a), using a non stretchable tape (Fig. 8b).

3.3.2.4 TRICEPS AND SUBSCAPULAR SKINFOLD-THICKNESS

The triceps and subscapular skinfold thicknesses were measured (Tanner, 1962) in millimeters with standard calipers (Holtain Ltd, Crymych, United Kingdom). Two skinfold readings were taken at each site and the average was used.

For the triceps, the place of measurement at the midpoint of the left upper arm over the triceps muscle is first marked with a pen (Fig. 8a). The skinfold parallel to the long axis of the arm is picked up with the thumb and forefinger of the examiner's left hand, and pulled away from the underlying muscle. The caliper is then applied to the fold a little below the fingers so that pressure is exerted by the caliper face, not the fingers. The examiner's fingers are then released from the handle of the caliper to permit the full force of the spring to be exerted on the fold. The dial is read to the nearest 0.1 mm immediately after the application of the spring's pressure (Fig. 9).

The subscapular skinfold was measured just below the inferior angle of the left scapula. The fold was picked up in the natural line of skin cleavage and the measurements taken in a fashion similar to that for the triceps (Fig. 10).

3.4 INTERVIEW DATA

3.4.1 AGE AND FEEDING HISTORY

In the FRG study, birthdate was determined from passport or birth certificate. Feeding histories were determined by interview of the parent or other guardian. In 3 of the 73 families studied, the parents or guardians were not present or could not provide information.

The feeding history included whether the child was breast-fed, and the reported ages when completely weaned, and when first given commercially-prepared solid baby food, cereals, juices, vegetables, fruits, meat, and table food.

3.4.2 SOCIO-ECONOMIC DATA

Socio-economic data were collected on the household type (nuclear family, extended family, or households with unrelated people), duration of residence in the camps and in the FRG. Also recorded were income per month per household, and the age, years of schooling, and occupation of each parent.

3.4.3 HEALTH STATUS AND OTHER FACTORS

Recent illness, defined as reported symptoms of fever, cough, or diarrhea in the week preceeding the examination, was determined by questioning the mother. The mouth of each child was examined and the investigator recorded the total number of teeth and the number decayed, missing, and filled. Information on birth weight of the subject, and child-care arrangements were also collected.

3.4.4 MATERNAL HEALTH KNOWLEDGE

To assess the subject's mother's knowledge about health, child care, and nutrition, a questionnaire written in Lao was administered. The questionnaire was composed of 20 questions selected from among successful questions in a 30-question pretest given in three German cities two months before the actual survey to 16 lowland Laotian mothers who did not have children in the target population (<72 months of age). Questions were answerable as "yes," "no," and "do not know." Six questions were about maternal and child care, 9 about health and disease, and 5 on the nutritional values of food (see Appendix 1).

A total of 63 (86%) of the 73 mothers completed the questionnaire; 54 answered the questionnaire themselves and 9 illiterate mothers had it read to them by the investigator. A "Knowledge Score (KS)" was

calculated based on the percent of questions answered correctly out of the total of 20 questions.

3.5 CALCULATIONS AND DATA ANALYSIS

3.5.1 ANTHROPOMETRIC INDICES (S.D.-scores)

For the surveys in both the Thailand camps and in the FRG, measurements of weight-for-age (W/A), height-for-age (H/A), and weight-for-height (W/H) were analyzed and standardized using National Center for Health Statistics (NCHS) reference standards adopted by the World Health Organization (NCHS, 1976). The S.D.- score (Z-score) for W/A, H/A, and W/H was calculated by standard methods (Waterlow, 1977; Lavoipierre, 1983), as follows:

3.5.1.1 WEIGHT-FOR-AGE (W/A)

$$\text{S.D.-score W/A} = \frac{\text{(individual's weight)} - \text{(median weight of reference population of same age as individual)}}{\text{(1 value of one standard deviation below or above the median weight of the reference population of the same age as the individual)}}$$

Formula for calculation of the S.D.-score of subject with a weight below the median weight for the subject's age of the NCHS/CDC/WHO reference standard.

To illustrate, take the example of a male child age 2 years and 7 months weighing 12.0 Kg. The reference data shows:

	WEIGHT (kg)						
AGE	-3 SD	-2 SD	-1 SD	Median	+1 SD	+2 SD	+3 SD
2y 7m	9.4	10.9	12.3	13.7	15.5	17.2	19.0

The value of 1 SD below the median weight in the reference population would thus be 13.7 - 12.3 = 1.4 kg.
The S.D.- score of the child would thus be:

$$\text{S.D. - score W/A} = \frac{12 - 13.7}{1.4} = -1.21$$

Formula for calculation of the S.D.-score of subject with a weight above the median weight for the subject's age of the NCHS/CDC/WHO reference population.

In the same population, a male child age 2 years and 7 months but weight 15 kg.

$$\text{S.D.-score W/A} = \frac{\text{(individual's weight) - (median weight of reference population of same age as individual)}}{\text{(value of one standard deviation above the median weight of the reference population of the same age as the individual)}}$$

The value of 1 SD above the median weight in the reference population would thus be 15.5-13.7 = 1.8 kg.

$$\text{S.D.-score W/A} = \frac{15-13.7}{1.8} = +0.72$$

3.5.1.2 HEIGHT-FOR-AGE (H/A)

$$\text{S.D.-score H/A} = \frac{\text{(individual's height)} - \text{(median height of reference population of same age as individual)}}{\text{(1 standard deviation of median height of reference population of same age as individual)}}$$

3.5.1.3 WEIGHT-FOR-HEIGHT (W/H)

$$\text{S.D.-score W/H} = \frac{\text{(individual's weight)} - \text{(median weight of reference population of same height as individual)}}{\text{1 standard deviation of median weight of reference population of same height as individual}}$$

3.5.2 ARM MUSCLE AND ARM FAT AREAS

Cross-sectional arm muscle area and arm fat area were calculated for each subject from measured left upper arm circumference and triceps skinfold thickness using formulas described more completely elsewhere (Frisancho, 1974; Martorell, 1976):

C = arm circumference (mm)
T = triceps skinfold thickness (mm)
pi = 3.14159

$$\text{ARM MUSCLE AREA (in square mm)} = \frac{(C - pi \times T)^2}{4 \times pi}$$

$$\text{ARM FAT AREA} = \text{ARM AREA} - \text{ARM MUSCLE AREA}$$

$$\text{ARM FAT AREA (in square mm)} = \frac{C^2}{4 \times pi} - \frac{(C - pi \times T)^2}{4 \times pi}$$

3.5.3 SKINFOLD THICKNESS

For both study populations, measured subscapular and triceps skinfold thicknesses were compared to median values for age of the German Dortmund children reference population (Reinken, 1980a).

3.5.4 CORRELATION

The coefficients of correlation between various anthropometric measurements and indices were calculated using a standard statistical computer package, SPSS (Nie, 1975).

3.5.5 FEEDING HISTORIES, BIRTHWEIGHT, INCOME

Feeding histories for subjects in the FRG were correlated with anthropometric indices using multiple regression analysis (Nie, 1975) to determine the coefficients of correlation between the age at first feeding of various foods (as independent variables) and the S.D.-scores for W/A, H/A, W/H, and the measurements of triceps and subscapular skinfold thickness (as dependent variables). Feeding histories were not determined for subjects in the Thailand camps due to the abnormal and changing conditions affecting feeding practices in this group. Birthweight and reported income were similarly correlated to these indices.

3.5.6 HEALTH KNOWLEDGE

The answers from each mother on the health knowledge questionnaire (Appendix I) were used to calculate a "Knowledge Score (KS)" based on the proportion of questions answered correctly (Dugdale, 1979):

$$\text{Knowledge Score (KS)} = \frac{\text{number of correct responses}}{20} \times 100$$

The relationships between the knowledge score (KS) of the mother and 1) the nutritional status of her child (as indicated by S.D.-score for W/A, H/A, and W/H), 2) her age, 3) her length of education, and 4) her length of stay in the FRG were determined using Spearman's methods of rank correlation and product moment correlation (Nie, 1975).

4. RESULTS

The mean values and standard errors of the mean (S.E.) for weight, height, arm circumference, triceps skinfold, and subscapular skinfold by age group are shown separately for girls and boys in Tables 1a. and 1b. No nutritional edema was detected in any of the subjects (see 5.5.1.3).

4.1 ANTHROPOMETRIC INDICES BASED ON WEIGHT AND HEIGHT

4.1.1 THAILAND vs. FRG vs. REFERENCE STANDARDS

The study subjects in the Thailand transit camps were found in several comparisons to be lighter and shorter than the subjects in the Federal Republic of Germany (FRG), and both groups were generally smaller than reference populations.

When plotted by age, the weights (see Fig. 11a and 11b) and the heights (see Fig. 12a and 12b) of Laotian girls and boys in the Thailand transit camps were generally below the 10th percentile of the German Dortmund reference population (Reinken, 1980a). Subjects in the FRG, however, were between the 10th and 50th percentiles of this population, suggesting an improvement in nutritional status following emigration to the FRG. These same figures also show that the German reference population was much heavier and taller than the American children who were measured for the international reference standards (NCHS, 1976).

4.1.2 S.D.-SCORES (W/A, H/A, W/H)

The cumulative frequencies distributions of S.D.-scores for weight-for-age (W/A), height-for-age (H/A), and weight-for-height (W/H) for the two groups of subjects are shown in Fig. 13a, 13b, and 13c, respectively. One can see the S.D.-scores of both Thailand and FRG groups are shifted leftwards, indicating the Laotian children are lighter and shorter than the NCHS reference population. Again, children in the Thailand camps were shorter and lighter than the Laotian children in the FRG.

In both populations, the distribution of S.D.-scores W/A and H/A are shifted more

leftwards than that of S.D.-score W/H. The 50th percentile of S.D.-score W/A of the reference population corresponded approximately to the 92nd percentile of the subjects in the Thailand camps and to the 75th percentile of the subjects in the FRG (Fig. 13a).

For S.D.-score H/A, the 50th percentile of the reference population corresponded approximately to the 88th percentile of the subjects in the Thailand camps and to the 75th percentile of the subjects in the FRG (Fig. 13b).

For the S.D.-score W/H, the 50th percentile of the reference population corresponded approximately to the 78 th percentile of the subjects in the camps and to the 65th percentile of the subjects in the FRG (Fig. 13c).

On the other hand, the cut-off point -2 S.D.-score (W/A) corresponded approximately to the 25th percentile of the subjects in the camps and to the 10th percentile of subjects in the FRG. For H/A, the cut-off point -2 S.D.-score corresponded approximately to the 30th percentile of the subjects in the camps and to the 6th percentile of the subjects in the FRG. For W/H, it corresponded to the 7th percentile of the Thailand camp subjects, and to the 3rd percentile of the FRG subjects.

Overall, the mean S.D.-scores of the subjects in Thailand were -1.35 (S.E 1.08) for W/A, -1.38 (S.E. 1.35) for H/A, and -0.67 (S.E. 0.99) for W/H. For the subjects studied in the FRG the mean S.D.-scores were significantly higher ($p<.001$) on each index than for those studied in Thailand: -0.63 (S.E. 1.03) for W/A, -0.60 (S.E. 1.25) for H/A, and -0.29 (S.E. 0.86) for W/H.

4.1.2.1 S.D.-SCORES BY SEX: GIRLS vs. BOYS

In the Thailand camps, girls had mean S.D.-scores that were significantly higher than that for boys for W/A ($p<.05$) and H/A ($p<.01$). There was no difference between boys and girls in W/H (see Fig. 14 and Tables 2a and 2b).

In the FRG, girls had significantly higher mean S.D.-scores than boys for W/A ($p<.02$) and W/H ($p<.02$), but there was no significant difference by sex for H/A.

4.1.2.2 S.D.-SCORES BY AGE GROUP

By age group, the subjects in Thailand were moderately lower than the reference standards in each age group for W/A (range -1.57 to -0.75), H/A (range -1.86 to -0.77), and W/H (range -0.99 to -0.28) (Fig. 15 a).

The age group 13-24 months possessed the lowest S.D.-scores W/A (-1.57) and W/H (-0.99). The age group 25-36 months possessed the lowest S.D.-score H/A (-1.86) (Fig. 15 b).

Similar measurements among Laotian children in the FRG yielded mean S.D.-scores that were slightly lower than the reference standards for most age groups for W/A (range -0.96 to +0.37), H/A (range -1.02 to +0.58), and W/H (range -0.55 to +0.26) (Fig. 15b).

The lowest S.D.- scores W/A (-0.96), W/H (-0.55) occured in age group 25- 36 months, and H/A (-1.02) in age group 61-72 months. In both groups, age group 2-12 months possessed the highest scores W/A, H/A and W/H (Fig. 15b).

4.1.2.3 S.D.-SCORES BY AGE GROUP BY SEX: GIRLS vs. GIRLS

The girls in the FRG had mean S.D.-scores that were significantly higher than that for girls in the Thailand camps; for W/A ($p<.0001$), H/A ($p<.0002$) and W/H ($p<.0002$) (Table 2a).

In the Thailand camps, the age group 25-36 months had the lowest mean S.D.-scores for W/A and H/A.

In the FRG, the lowest mean S.D.-scores for W/A and W/H occured in age group 49-60 months. The age group 25-36 months had the lowest mean S.D.-score H/A (Table 2a).

4.1.2.4 S.D.-SCORES BY AGE GROUP BY SEX: BOYS vs. BOYS

The boys in the FRG had mean S.D.-scores that were significantly higher than that for boys in Thailand camps; for W/A ($p<.0001$), H/A ($p<.0001$) and W/H ($p<.02$) (Table 2b).

In Thailand camps, the age group 49-60 months had the lowest mean S.D.-score for W/A and W/H. The age group 25-36 months had the lowest S.D.-score for H/A.

In the FRG, the age group 61-72 months had the lowest mean S.D.-scores for W/A and H/A. The lowest S.D.-score W/H was found in age group 25-36 months.

4.1.3 WASTING AND STUNTING

The proportion of children wasted (≤ 2 S.D. below the reference median W/H) was not significantly different ($.10>p>.05$) between the two locations: 9.5% (30/315) in the Thailand camps and 3.9% (4/102) in the FRG (see Table 3). The ratio of the proportion of wasting observed with the proportion expected from the reference standard (O/E) was 4.2 (9.5%/2.28%) in the camps and was 1.7 (3.9%/2.28%) in the FRG.

The proportion of children stunted (≤ 2 S.D. below the reference median H/A) was significantly higher ($p<.001$) in the camps (27.6%, 87/315) than in the FRG (6.9%, 7/102) (Table 3). The proportion of stunting observed to that expected (O/E) in the camps was 12.1 (27.6%/2.28%) and in the FRG was 3.0 (6.9%/2.28%).

Using stricter definitions of stunting (≤ 2.5 and ≤ 3 standard deviations below the reference mean/median), the proportion of children stunted in the camps (≤ 2.5 S.D.: 18.7% [59/315], <3 S.D.: 10.8% [34/315]) were still significantly higher ($p<.001$) than in the FRG (4.9% [5/102] and 1.0% [1/102], respectively).

In the Thailand camps, wasting was prevalent in age group 13-24 months (3.8%) and stunting in age group 25-36 months (10.2%), (Table 3).

In the FRG, wasting (2%) and stunting (3.9%) was prevalent in age group 25-36 months.

There was however no significant relationship between stunting and wasting. In the Thailand camps, only 1.9% (6/315) were stunted and at the same time wasted, in the FRG it was also 1% (1/102).

4.1.4 ANTHROPOMETRIC INDICATORS OF LAO-BORNS AND FRG-BORNS

In the FRG group, subjects born in Laos (n=35) were compared to subjects born in the FRG (n=49). There were no significant differences between the two groups in W/A, H/A, W/H, nor measurements of arm circumference, triceps and subscapular skinfold, nor reported birthweight.

The average birthweight of the Lao-born subjects was 3072 grams (S.D. 112.5) and of the FRG-born subjects was 3084.8 grams (S.D. 68.4). Arm circumference of the Lao-born subjects was 16.4 cm (S.D. 1.2) and significantly higher than that of the FRG-born subjects, which was 14.8 cm (S.D. 0.19).

4.2 MID-UPPER-ARM CIRCUMFERENCE

The mid-upper-arm circumference (MUAC) of the children in the Thailand camps was appreciably lower than the 10th percentile of the German Dortmund reference population (Reinken, 1980; see Fig. 16a and 16b) while the MUAC for study subjects in the FRG was generally midway between the 10th and 50th percentiles.

GIRLS

The MUAC of the Thailand camp girls ranged from 12.7 cm (in age group 2-12 months) to 14.7 cm (in age group 37-48 months). In the FRG-girls, it ranged from 13.8 cm (in age group 2-12 months) to 17 cm (in age group 61-72 months).

BOYS

The MUAC of the Thailand camp boys ranged from 12.9 cm (in age group 2-12 months) to 14.3 cm (in age group 49-60 months). In the FRG-boys, it ranged from 15 cm (in age group 2-12 months) to 16.3 cm (in age group 61-72 months).

Using 12.5 cm of MUAC as a lower limit of normal (Trowbridge, 1979a; 1980) as used in a previous study of this population (O'Sullivan, 1980), 13.3% (42/315) of subjects in the Thailand camps and 2.9% (3/102) in the FRG were below normal ($p<.01$).

4.3 TRICEPS AND SUBSCAPULAR SKINFOLD THICKNESS

TRICEPS SKINFOLD THICKNESS

Children in the Thailand camps had triceps skinfold thicknesses that were around the 10th percentile of the German Dortmund reference population (Reinken, 1980b) (see Fig. 17a and 17b). Subjects in the FRG generally measured between the 10th and 50th percentiles of the standard.

GIRLS

In Thailand camp girls, the triceps skinfold thickness in each age group varied very little and ranged from 7.02 mm (in age group 2-12 months) to 7.6 mm (in age group 49-60 months) (Fig. 17a).

In FRG-girls, it ranged from 7.0 mm (in age group 37-48 months) to 9.9 mm (in age group 2-12 months) (Fig. 17a).

BOYS

The triceps skinfold thickness of the Thailand camp boys ranged from 6.3 mm (in age group 49-60 months) to 7.4 mm (in age group 25-36 months). In FRG-boys, it ranged from 6.8 mm (in age group 61-72 months) to 9.2 mm (in age group 2-12 months).

SUBSCAPULAR SKINFOLD THICKNESS

In contrast, subscapular skinfold thicknesses of subjects in both the Thailand camps and the FRG generally measured above the reference standard (see Fig. 18a and 18b).

GIRLS

In Thailand camps, the subscapular skinfold thickness varied very little, and ranged from 5.6 mm (in age group 49-60 months) to 6.35 mm (in age group 2-12 months). In the FRG, it ranged from 5.0 mm (in age group 49-60 months) to 8.1 mm (in age group 2-12 months) (Fig. 18a).

BOYS

The subscapular skinfold thickness in the Thailand camp boys ranged from 4.8 mm (in age group 49-60 months) to 6.5 mm (in age group 2-12 months). In the FRG-boys, it ranged from 5.0 mm (in age group 61-72 months) to 6.3 mm (in age group 2-12 months) (Fig.18b).

4.4 ARM MUSCLE AREA

In general, subjects in the FRG had arm muscle areas that were markedly larger than subjects in the Thailand camps (Fig. 19). Both girls and boys in the Thailand camps had cross-sectional arm muscle areas that generally were greater than the 5th percentile, but less than or just equal to the 10th percentile of the reference population from the U.S. Health Examination Survey I of 1971 to 1974 (Frisancho, 1981) (see Fig. 19). The one exception was girls in the 4-4.9 year age group, whose median arm muscle area was less than the 5th percentile. There is no reference population for arm muscle areas for age less than one year. There was also no available German Dortmund reference datas for arm muscle area and arm fat area.

In contrast, girls in the FRG had median arm muscle areas that in three age-groups (2-2.9, 3-3.9, and 5-5.9 years) were just equal to or between the 25th and 50th percentiles, and in two age groups (1-1.9 and 4-4.9 years) were greater than the 50th percentile. All age groups, except one, of boys in the FRG had median arm muscle areas between the 25th and 50th percentiles (the 5-5.9 year age group was between the 10th and 25th percentiles).

4.5 ARM FAT AREA

As with arm muscle area; the arm fat area of FRG subjects was markedly greater than that of the Thailand subjects (see Fig.20). Girls and boys in Thailand camps had cross-sectional arm fat areas that were less than the 10th percentile of a reference population (Frisancho, 1981). One age group of these girls (2-2.9 years) and two age groups of these boys (1-1.9, 3-3.9) had median values that were also less than the 5th percentile.

Among Laotians in the FRG, there was greater variability in median arm fat areas between the

sexes and different age groups. For girls, one age group (4-4.9 years had a median arm fat area between the 5th and 10th percentiles, three age groups (1-1.9, 2-2.9, and 3-3.9 years) between the 10th and 25th percentiles, and one age group (5-5.9 years) between the 25th and 50th percentiles. Boys in the FRG, in general, had smaller arm fat areas than the girls. Two age groups of boys (2-2.9 and 3-3.9) were between the 5th and 10th percentiles, two (1-1.9 and 5-5.9 years) were between the 10th and 25th percentiles, and one (4-4.9 years) was between the 25th and 50th percentiles.

4.6 RELATIONSHIP BETWEEN ANTHROPOMETRIC INDICES

Table 4 lists statistically significant correlation coefficients between various combinations of independent and dependent variables. As might be expected, age was significantly correlated with most direct measures of body mass (weight) and size (height, arm circumference, subscapular skinfold), but not triceps skinfold. Age did not correlate with the S.D.-scores W/A, H/A and W/H.

Arm circumference correlated strongly with both weight (coefficient of correlation [Cr] = 0.773 and 0.799 in the camps and in the FRG, respectively) and height (Cr = 0.650 and 0.729, respectively). Triceps skinfold and subscapular skinfold appeared to have no dependence on each other. Both skinfold measures correlated with W/A and W/H but not H/A.

4.7 FEEDING PATTERNS IN THE FRG

Of the 102 study subjects in the FRG on whom feeding histories were obtained, 49 (48%) were born in the FRG, 18 (18%) were born in refugee camps in Thailand, and 35 (34%) were born in Laos. The FRG-born children ranged in age from 2 to 34 months, Thailand-born from 14 to 69 months, and the Laos-born from 36 to 72 months.

Study subjects born in the FRG were completely weaned at a mean age of 9 months, which was significantly younger ($p<.001$) than the 18 months mean age at which subjects who had been born in Laos were completely weaned (see Table 5). Subjects born in Thailand refugee camps were excluded from this analysis because of the abnormal and variable conditions affecting feeding

practices in the camps. FRG-born subjects were first offered juices, vegetables, fruits, meat, and table food at significantly younger ages ($p<.001$) than those subjects born in Laos. Cereals, however, were first offered to FRG-born subjects at a later mean age (7 months) than Laos-born subjects (4 months). FRG study subjects who were also born in the FRG received earlier supplementary foods and were weaned earlier than those subjects born in Laos. Meat, however, was offered at the same age (9 months) in the two groups.

The results of multiple regression analysis between feeding history and anthropometric indicators showed that improvement of anthropometric indicators was influenced by earlier introduction of supplementary food. This was reflected more in S.D.-score W/H than in other anthropometric indicators. 28% of variations in the value of S.D.-score W/H, 20% in triceps skinfold thickness but only 16% in subscapular thickness and 13% in S.D.-score W/A can be explained by supplementary feeding (Table 5).

The mean age at which certain supplemental foods were first offered had significant negative correlations with several anthropometric indices (see Table 5). Earlier weaning associated with improved S.D.-scores W/A, W/H, triceps and subscapular skinfold thickness. The earlier introduction of meat correlated significantly with higher S.D.-scores for W/A (Cr =-0.237), W/H (Cr = -0.374), triceps skinfold (Cr = -0.150), and subscapular skinfold (Cr = -0.286) (Table 5).

Introduction of commercially baby food correlated significantly only with S.D.-score W/H, introduction of juices with subscapular thickness, vegetables with S.D.-score W/H and subscapular thickness, cereals with S.D.-score W/H and triceps skinfold thickness, fruits and table food with suscapular thickness.

The S.D.-score of height-for-age did not correlate with the age of weaning, nor the age at which any of the foods were first offered.

4.8 MILK FEEDING

In the FRG, exclusive breast-feeding was reported for 6% (3/51) of FRG-born refugees, for 44% (8/18) of the Thailand-born subjects, and for 45% (15/33) of Laos-born subjects (see Table 6). The different proportions between FRG-born and

Laos-born children was statistically significant ($p<.01$).

The opposite trend was reported for the exclusive feeding of commercially-prepared formula, which was reported for 39% (20/51) of the FRG-born, 17% (3/18) of the Thailand-born subjects, and for 9% (3/33) of Laos-born subjects. Again, the different proportions between FRG-born and Thailand-born children was statistically significant ($p<.01$).

The exclusive use of sweetened condensed milk was reported only for 2 (6%) of the 33 Laos-born subjects, but for none of the FRG or Thailand-born ones.

A few children were fed various combinations of milk. The proportions of subjects reported to receive at least some breast-milk was 61% (31/51) among the FRG-born, 78% (14/18) among the Thailand-born, and 79% (26/33) among the Laos-born.

4.9 DMFT (DECAYED, MISSING, FILLED TEETH)

There was no significant correlation between DMFT and anthropometric indicators. The prevalence of DMFT was highest in age group 49-60 months (mean = 12.6, S.D.= 6.2), and lowest in age group less than one year. The prevalence of DMFT of the FRG-lao subjects, when compared with that of the German children (Stormarn, Hamburg) (Gülzow, 1985) was significantly higher ($p<.0005$), indicating the bad oral hygiene condition (Table 7). Among age group 49-60 months, more than half of their teeth (60.9%) were carious. The datas of DMFT of the German preschool children age less than 3 years were not available. The global oral epidemiology bank of the world health organization (1986) reported the current prevalence of DMFT of Laotian children, age 6 years in the Laos People's Democratic Republic varied from place to place and ranged from 0.1 to 7.9. However the number of subjects under each study was rather small, ranged from 20 to 46.

4.10 SOCIO-ECONOMIC DATA

4.10.1 FAMILY TYPE AND CHILD-CARE

53 (73%) of the 73 families of the subjects were "nuclear", defined as including only the husband, wife, and their children (Table 8).

There were 15 (21%) "extended" families which included other relatives. There were also 3 (4%) families that included unrelated people, and there was 1 (1%) family in which husband and wife were separated. 1 (1%) was not known.

The daytime caretaker of the FRG study subjects was the mother in 76% (53/70) of the families, another relative in 16% (11/70), a child-care facility for 7% (5/70), and the father in one case (1%). Of 70 mothers, 19% (13/70) are working and 81% (57/70) are not working.

4.10.2 PARENTAL AGE, EDUCATION, RESIDENCE HISTORY

The 106 FRG subjects came from 73 families (see Table 8). The average age of their mothers (n = 68) was 27 years (S.D. 5.9) and their fathers (n = 65) was 32 (S.D. 7.7) years. The mother had an average of 7 years (S.D. 3.5) of schooling, compared to a mean of 10 years (S.D. 3.2) of schooling by the fathers. The duration of maternal residence in the camps averaged 13 (S.D. 11) months, with a range from 1 month to 60 months. The duration of maternal residence in the FRG averaged 32 months (S.D. 8), with a range from 9 to 45 months.

There was no significant correlation between parental age, years of schooling, or duration of residence in the camps or FRG and W/A, H/A, W/H, and triceps or subscapular skinfold thickness.

4.10.3 PARENTAL INCOME AND EMPLOYMENT

Only 51 of the FRG families were willing to provide information on their income. The average monthly income was 1,939 DM (approximately US $880, 2.2DM/US$), with a range from 800 DM to 3000 DM. There was a signficant negative correlation between family income and H/A (Cr = -0.240, $p<.01$), but no correlation with W/A, W/H, triceps, nor subscapular skinfold thickness.

The former occupations of the parents when they lived in Laos are listed in Table 9. The most frequently reported job categories for the fathers were skilled workers (34%) government officials (22%), employees (15%), and students (10%). (Information was not available on one father who was divorced and separated from his wife and children.) For the 73 mothers, the most

frequent occupations in Laos were housewife (37%), government officials (21%), and students (15%).

The current occupations of the parents in the FRG are also listed in Table 9. The great majority (67%) of the 73 fathers were general labourers. Most (70%) of the 73 mothers were housewives (never employed outside the home), while 19/73 (26%) mothers reported employment outside the home in the FRG, and 1/73 (1%) said they were unemployed.

4.11 HEALTH STATUS AND BIRTHWEIGHT

Among the subjects in the FRG, Cough (30%) and fever (17%) were relatively common symptoms; diarrhea (4%) was rare (see Table 8).

The mean birthweight of 90 subjects in which the data were available was 3,052 grams (S.D. 497 grams). There were significant correlations of birthweight to W/A (Cr =0.220, $p<.01$), H/A (Cr = 0.181, $p<.01$), and subscapular skinfold thickness (Cr =0.256, $p<.05$). Birthweight did not correlate with W/H, triceps skinfold thickness, nor maternal age.

4.12 HEALTH KNOWLEDGE

The mean Knowledge Score (KS), or the proportion of correct answers to the 20 questions, was 35.0%, with a range from 90% to 15% (see Appendices I and II). The subjects about which mothers tended to answer correctly concerned the health effects of excessive alcohol, smoking, and sweets. The questions most frequently answered correctly were no. 9 (86% of the mothers correct), no. 12 (85% correct), and no. 14 (82% correct). Subjects answered correctly by only about half the mothers concerned vaccination (no. 8, 50%), pregnancy dietary restriction (no. 6, 47%), and breast milk immunity (no. 7, 38%).

The subjects about which mothers tended to answer incorrectly were in the areas of the nutritional value and health effects of various foods. Only 13% of mothers knew that sweetened condensed milk should not be used to feed infants (no. 11). Most (>90%) Laotian mothers believed fresh food is better than frozen food, pork than meat, honey than sugar and tea is nutritionally better than coffee. 90% believed that regular intake of vitamin B complex provided an extra energy. The accuracy of knowledge on the areas of

diabetes, cholesterol and the effect of salt in increasing blood pressure were very low (2%), and most mothers admitted they do not know.

There was no significant relationship between the accuracy of knowledge (KS) of the Laotian mothers and their education, age, duration of residence in the FRG nor the S.D.-scores of their children.

5. DISCUSSION

5.1 NUTRITIONAL STATUS OF LAOTIAN REFUGEES

5.1.1 PREVIOUS STUDIES

There is little available published data on the nutritional status of refugees from Laos who emigrated to the Federal Republic of Germany (FRG) after 1975. Feldmeier (1981) reported on 492 Indochinese refugees, 447 Vietnamese and 45 Laotian, who enterered Hamburg, FRG from July 1979 to June 1980. He did not analyze by nationality, but found 60.9% of children <5 years of age were undernourished having arm circumference <13 cm. Of the children from 5 to 10 years of age, 29.7% of the girls and 39.4% of the boys were less than 80% of the median W/H of the Harvard standards.

A few published studies of similar refugees who emigrated to other countries during this period showed that stunting was usual among the Laotian children, but that wasting appeared to vary by the time and place of the survey. One study conducted in 1979 and 1980 found 30% of the Laotian children in the Khao-I-Dang and Nong Khai refugee camps in Thailand to be wasted (Olness, 1984). In contrast, only 3% of a group of refugee children arriving in the United States in 1979 and 1980 were found to be wasted, although 38% of the children were stunted (CDC, 1980b; Peck, 1981). In this same study, 39% had blood hemoglobin concentrations less than 10 gm/100 ml, compared to 13% in a control population. Another 1979 study in Ubol, Thailand found 7.5% of Laotian refugee children to have mid-upper-arm circumference less than 12.5 cm (O'Sullivan, 1980).

5.1.2 SAMPLE SELECTION

Conclusions about the two populations sampled in this study--Laotian children in Thailand transit camps and in the FRG--must be made cautiously. Although both samples are believed to have included the majority of the target populations of Laotian children in each location, neither sample was chosen randomly.

It may have been possible the samples were biased, for example, if in the Thailand camps undernourished children were not included because they were kept home or in a clinic or hospital due to illness. In the FRG, there may have been bias towards well-nourished or undernourished children if, for example, families of particularly low or high socio-economic status were under-represented among the member families and contacts of the Laotian resident's association through which the families were contacted.

5.1.3 COMPARISON OF THAILAND AND FRG STUDY GROUPS

It should be stressed that the study subjects were not a single cohort followed longitudinally from Thailand to the FRG; each group was a different population. The refugees studied in Thailand eventually emigrated to many different countries. (None of the 315 subjects studied in Thailand turned up in the FRG survey the following year.) Certain biases may have occurred in the selection of those families accepted for emigration to the FRG, compared to those accepted by other countries.

Nevertheless, the data suggest that significant improvements have occurred in the nutritional status of Lowland Lao refugee children after emigration from Thailand transit camps to the FRG. The mean S.D.-scores for all three indices (W/A, H/A, and W/H) were significantly higher in the FRG group than in the Thailand group ($p<.001$, Fig. 14). Mean S.D.-scores, W/A went from -1.35 to -0.63, H/A from -1.38 to -0.60, and W/H from -0.67 to -0.29 (see Section 4.1.2).

The rate of wasting in the FRG group was decreased by three-fifths (from 9.5% to 3.9%), and stunting was decreased by three-fourths (from 27.6% to 6.9%) compared to the Thailand group.

These differences, if not an artifact resulting from bias, as mentioned above, may result from the improved health, sanitation, hygiene, diet, feeding habits, income, and family stability in their new homeland compared to the situation in the refugee camps.

5.1.4 WASTING AND STUNTING

This study found stunting to be more common than wasting in both the Thailand and FRG groups (see section 4.1.3 and Table 3). This is similar to the findings of other studies in other Thailand camps (Olness, 1984), and in Southeast Asian refugees arriving in the USA (Peck, 1981). One possible explanation is that adequate food supplies in the camps at the time of the surveys avoided acute malnutrition, but could not remedy the chronic deprivations these children may have faced earlier in their lives, which affected their height.

The marked decrease in stunting in the FRG group compared to the Thailand group may be artifactual, as mentioned earlier. But an alternative explanation might be catch-up growth in height that occurred after arrival in the FRG, which has been postulated elsewhere (Olness, 1984).

5.1.5 SKINFOLD THICKNESS

Body fat measured by triceps skinfold thickness revealed a depletion of energy stores in both boys and girls in Thailand, with low normal measurements among those in the FRG (see section 4.3 and Fig.17a, 17b, 18a, and 18b). But measurement of subscapular skinfold thickness revealed a paradoxical pattern: although triceps skinfolds were lower than the reference standards in both countries, subscapular skinfolds were generally higher in both groups.

It is unlikely this paradoxical pattern is due to differences in measuring technique. The measurements in this study were performed by the same investigator using the same equipment for both measurements. The measurement was taken in a standardized manner and as it was described for the German reference. The only difference was that the German reference was taken from the right arm when it was the left arm in this study and in other international references. (Frisancho, 1981, Tanner, 1962). There was however no significant difference between the measurement in left and right arm (Burgert, 1979). This, therefore could not possibly affect the measurement.

One possible explanation for this finding may be ethnic or climatic differences in fat deposition. There may be a different pattern of fat deposition between the Laotian children in this study and the German and American children who were used to develop the reference standards. Several studies have shown ethnic differences in skinfold thickness (Robson, 1971; Etta,1979).

Another possible explanation was due to the following hypothesis. The results indicated the accumulation of subcutaneous fat among these Laotian refugee children, but such somatic development, especially during the critical periods of energy shortage is usually not favourable. In the subscapular region, there is a thermo-regulating fat organ for non shivering thermogenesis (Dawkins 1965, Niemitz, 1984), which is, (under normal condition of energy supply and without cold stress) converted rapidly into white storage fat. This process is irreversible and this fat organ can not later on be detected. The study of newborn rodents reported that the interscapular brown fat is not converted into white storage fat, when these animals are kept under cold stress (Brück, 1978, Lindberg, 1970). In malnourished baby, all brown fat tissues are very resistant against depletion. Niemitz suggested that the unfavourable conditions, together with energy shortage in the camps create a depletion of white subcutaneous fat in the trunk and the extremities and at the same time caused a loss of thermo-insulation through catabolic processes. Brooke (1973), Hey (1969) reported hypothermia is usually the case among the young babies, living in refugee camps. Niemitz, therefore postulated that unfavourable condition in the camps, caused decreased insulation inside the body and this may have triggerd cold stress and in order to keep the interscapular thermoregulator in sufficient function, the body is therefore force to minimize its energy expenditure.

5.1.6 ARM MUSCLE AREA AND ARM FAT AREA

Arm muscle area is an indicator of muscle mass, and thus an indirect indicator of body protein reserves. Arm fat area, like skinfold thickness, is a measure of total body energy reserves. These measurements demonstrated depletion of both protein and energy reserves in both boys and girls in the Thailand refugee camps (see sections 4.4, 4.5 and Fig. 19 and 20), compared to the reference population (Frisancho, 1981). These measurement in the FRG suggested that protein reserve was normal but energy store was still quite low, see Fig. 20. normal in subjects in the FRG.

5.1.7 GIRLS vs. BOYS

Boys in Saudi Arabia, Bangladesh and Thailand usually outperform girls on nutritional indicies (Abaheseen 1981, Chen, 1981, Glasuer, 1982). So it is paradoxical that the Laotian girls in the FRG had significantly higher W/A and W/H S.D.-scores than the Laotian boys (see section 4.1.2.1 and Tables 2a. and 2b.). Girls in the FRG had a significant higher mean S.D.-scores W/A and W/H than the boys, and in Thailand they outperformed the boys on W/A and H/A. It is probable that in FRG the girls were able to adjust themselves to the new environment sooner than the boys and this was reflected in having better current nutritional status (W/A and W/H) than boys.

5.2 FEEDING PATTERNS

5.2.1 BREAST FEEDING

The decline of breast-feeding among FRG-born children (see section 4.8 and Table 6) may be due to several factors, including the influence of Western feeding practices, indirect commercial-formula advertising, and perhaps undernutrition of some of the mothers. Bergevin (1983) reported in Canada, the infant formula samples have shown to shorten the duration of breast-feeding and hasten the age at which solid foods are introduced. Mothers who are undernourished may produce less milk (Chavez, 1975; Hanafy, 1972). Although maternal nutrition may have been worse in the camps, bottle feeding was

actively discouraged or even prohibited in the refugee camps. Some of the mothers of the study subjects told the investigator that they had insufficient breast milk, and she noted subjectively that some of the mothers were thin and pale. Economic and social stresses in their new life in the FRG might contribute to some maternal malnutrition, although the assessment of this was not included in this study.

5.2.2 WEANING

Several significant correlations were found between earlier feeding of various foods (e.g., meat, commercial baby food, and cereal) and higher S.D.-scores on various anthropometric indices (e.g., W/H and skinfold thickness). Our study found that refugees in the FRG received supplementary feedings at an earlier age and were weaned earlier than refugees in the Thailand camps. Their improved nutritional status compared to subjects in the Thai camps may be the result of this earlier food supplementation.

5.3 FACTORS INFLUENCING NUTRITIONAL STATUS

5.3.1 MIGRATION

Migration has been shown to have a significant effect on changing body stature (Boas, 1982). Children of migrants have been found taller than their parents. Japanese born in the U.S.A. were taller than Japanese born in Japan (Froelich, 1970; Greulich, 1957; Kagan, 1974;). American-born Chinese were also taller than Chinese immigrants to the U.S.A. (Lasker, 1946). Such differences are thought to be influenced mainly by better socio-economic status and adequate nutrition.

In this study, the feeding behavior of the Laotian mothers changed markedly after migration to the FRG. This may be a major factor in the apparent improvement demonstrated here in the nutritional status of their children. No significant differences in the FRG, however, could be demonstrated for Laos-born children and FRG-born children in any indices or measurements (see section 4.1.4).

However ,it should be noted that despite the improvement of anthropometric indicators, the oral hygiene condition of these children has not at all improved. The unusual high number of DMFT in almost every age group indicated that dental caries is a serious problem among this group. Dental caries results from the interaction of these interdependent variables: a susceptible host (the teeth and surrounding saliva), a cariogenic diet and the pathogenic microorganisms. The factors which contributed to this high prevalence of dental caries were beyond scope of this study.

5.3.2 SOCIO-ECONOMIC STATUS

Several studies have shown that child growth is influenced mainly by socio-economic status (Graitcer, 1981; Rao, 1976; Vijairaghaven, 1971 and 1974). Offsprings of wealthier parents were larger than those of poor parents in England (Clements, 1953), the United States (Hathaway, 1957), Nigeria (Collis, 1962), India (Udani, 1963), Hongkong (Chang, 1963) and Jamaica (Ashcroft, 1964).

On the other hand, a few studies in Thailand and the Phillipines have shown unexpected malnutrition among children in groups with incomes above the lowest levels (Boonperm, 1984, Taylor, 1978). In Bangladesh, the higher income was of more benefit to children of literate mothers than to those of illiterate mothers (Bairagi, 1980). Surplus income may be used to purchase items other than better quality food (protein) for children. Higher income may result from increased working hours by parents, resulting in less time for caring and feeding children.

Although this study found a negative correlation between family income and H/A score of the children (see section 4.10.3), it is not possible to draw any firm conclusions from this finding. First, information on income was difficult to obtain and not possible to corroborate. Twenty-two families (30%) of the 73 families refused to answer this question. Much of the furniture in the homes was donated by the sponsors ("Betreuer") of the families, and thus their material possessions could not be used as an indirect marker of income. At this early

stage in their life in their new homeland there was relative homogeneity in their incomes; most worked primarily as laborers. Finding socio-economic effects on nutritional status may require waiting long enough for the integration of some of these families into higher income categories as their educational levels and economic levels increase.

5.3.3 ENVIRONMENTAL FACTORS

Various factors classified as environmental have been reported to influence the weight and height of children, although many of these may be considered socio-economic factors as well (Topp, 1970). These factors include social class, number of siblings, and number of working hours the mother was employed, family size, number of rooms at home, and sharing of beds. Weight for height was associated with the number of siblings and the number of hours for which the mothers were employed. Children from larger family with more sibling were lighter and shorter than those from small family and less siblings (Topp, 1970). However such factors were not investigated in this study, primarily because there was little heterogeneity in such environmental (and socio-economic) factors among the families in the target populations. The majority of the Laotian refugees were formerly middle class town dwellers, mostly from Vientiane; very few were peasants. There was little variation in the income and educational levels of the parents (see sections 4.10.2, 4.10.3, and Table 8).

5.3.4 GENETIC FACTORS

Although genetic factors clearly influence ultimate adult height, and affect the growth of <u>individual</u> children, there is some controversy whether such factors operate at the <u>populations</u> level at the preschool ages included in this study. Many feel that the growth of a population of children under five, given optimum conditions, is independent of genetic influence, and that the reference standards are applicable to all races and ethnic groups at this age (Habicht, 1974; Egoramaiphol, 1980; Graitcer, 1981). (It should be noted, however, that all

members of the multi-racial U.S. population used to derive the reference standards cannot be considered to have grown under optimum conditions.)

Habicht (1974) showed that the weight and height differences attributable to race in preschool children was about 3% for height and about 6% for weight. This was negligible compared to the differences due to socio-economic factors, which were about 12% for height and 30% for weight. Graitcer (1981) found that children from privileged elite groups in developing countries (Egypt, Togo, and Haiti) did not differ greatly in H/A from the NCHS reference population. They were actually heavier than the reference population at heights greater than 100cm, and overnutrition among these privileged groups was postulated. Egoramaiphol (1980) found that the weight for height of the Bangkok well-to-do preschool children was not different from that of the NCHS/CDC/WHO reference population.

On the other hand, Garn (1966) reported in his Ohio growth study that parental height was a factor in determining the height for age of a child, quoted by Dugdale (1970). Dugdale (1970) studied preschool children up to 7 years of age from Australia and Malaysia and concluded that although socioeconomic factors were most influential, genetic factors came into play when other factors including nutrition, were optimal. Genetic differences in growth were reported between Asians and Europeans, and to a lesser extent between Europeans and Africans (Ashcroft, 1964, 1976; Tanner, 1976). In Kingston, on the island of Jamaica, Chinese and Indian children were consistently shorter and smaller than children of African, European and Afro-European origin (Ashcroft, 1976). The African children had greater W/H and greater arm circumference, but smaller triceps skinfold thickness, than Indian children.

Jenss (1940) also found that children aged 6 to 8 years of American-born parents and ancestry showed a greater mean weight and height gain than American children of Italian parentage of the same socio-economic background. Difference in body size and proportion between Mexican-American and Anglo American infants has also been observed.

The Mexican-American infants were generally larger in terms of weight, length, chest and thigh circumference and subscapular skinfold thickness than the Anglo-Americans (Kautz, 1981).

Although the Laotian children in the FRG have demonstrated a significant improvement in most anthropometric indicators, compared to their fellow countrymen in the Thailand refugee camps, they are still considerably smaller, on average, than the American and German reference populations. Since optimal conditions for growth obviously did not exist for them, and since there were vast differences in social, economic, and environmental influences between the refugees and the reference populations, one can draw no conclusions from this study about the effect, if any, of genetic or ethnic influences on growth. Habicht (1974) however reported that children from developing countries (India, Columbia, Thailand, West Africa, Gutemala) were capable to attain the same growth until the age of 6 months and after that they lag behind those of developed countries (USA, United Kingdom, Australia, and Japan).

5.3.5 INFANT FEEDING PRACTICES

This study found that earlier weaning and earlier supplementation with certain foods, especially meat, correlated significantly with improved nutritional status (see section 4.7 and Table 5). This was consistent with previous reports that exclusive breast feeding longer than six months was associated with low W/A, H/A, and W/H (Victora, 1984). In two studies of lactating women, it was reported that breast milk alone failed to supply the energy needs of infants after 3 months (Waterlow, 1979) and 4 months (Lauber, 1981), respectively.

Migration to the FRG had a striking effect in decreasing the length of breastfeeding for FRG-born Laotian children (mean: 9 months), compared to the mean age (18 months) when Laos-born children were taken off the breast. The duration of breast feeding is the result of an interplay of many economic and cultural factors, which are greatly influenced by migration. Prolonged breast feeding, i.e., longer than six months,

is common in developing countries. In one study in rural Thailand, 81% of children were breastfed 12 months or longer (Tontisirin, 1983). In urban low-income communities in Hyderabad, India, breast feeding was prolonged up to 24 months (Prema, 1982). Among urban Egyptian mothers, the duration of breast feeding was shorter among those with higher income, higher education, and those working outside the home (El-Mougi, 1981).

5.3.6 MATERNAL FACTORS

Maternal smoking and age influences birthweight, and maternal nutrition influences breastmilk production. Gormicon (1980) found smoking during pregnancy caused a reduction in birth weight. Frisancho (1983) found young adolescent mothers (ages 13 to 15) in Peru produced shorter and lighter newborns than older mothers. He also found that those young mothers who were still growing in height themselves produced smaller babies than those who had completed their growth (Frisancho, 1984). Although we did not determine the prevalence of smoking in the Laotian mothers in this study, it is probably quite low. We found no correlation between the age of the Laotian mothers in the FRG and the reported birthweight of their children, although the mothers in this study were older (18 to 45 years) than the adolescents studied by Frisancho (1984).

Hanafy (1972) and Chavez (1975) found malnourished mothers produced breastmilk of low concentrations of protein and lactose. Although some of the Laotian mothers complained of insufficient breastmilk, and appeared pale and thin to the investigator, maternal nutritional status and milk production were outside the scope of this study.

5.3.7 INFECTION

Infection can markedly influence nutritional status. Several studies have found that diarrhoea of various etiologies was strongly associated with failure to grow in weight and in height (Levinson, 1974; Rowland, 1977; Baumgartner, 1983). Other infectious diseases such as measles and whooping cough have been found to interfere

with weight gain (Mata, 1977; Nabarro, 1984). Baumgartner (1983) found, however, that upper respiratory infections during the first year of life did not deter weight gain among well-nourished children in Taiwan.

We found the point prevalence of symptoms of cough, fever, and diarrhea to be low in Laotian children in the FRG (see section 4.11 and Table 8). But our methods did not allow determination of the incidence of illness in the past, nor the presence of chronic infections. Studies of arriving Indochinese refugees in the U.S.A. found the overall prevalence of tuberculosis was 1,138 per 100,000 refugees (CDC, 1981), but the rate among Laotians was about one-half the rate in Kampucheans and Vietnamese. Other studies in the U.S.A. found a variety of intestinal parasites (CDC, 1979a, 1979b, 1979c, 1979d, 1979e, and 1980a) in new refugees, but the effect of parasitic infections, per se, on nutritional status is not proven.

5.3.8 SEASONALITY

Seasonal changes in nutritional status have been observed primarily in agricultural societies in developing countries. In Africa, weight fluctuations varied with food production cycles (Wilmsen, 1978). In Sudan, the children grow slower in dry season than in rainy season (Ojaba, 1985). In Matlab Thana, Comilla District in Bangladesh population, the nutritional status of the mothers were worst during August and September, when there is no rice harvest (Chen, 1979). This was however more pronounced in mothers from landless families than those from landowning families. Trowbridge (1979b) observed that W/H was more sensitive to seasonal fluctation than other anthropometric indicators. Accordingly, in developing countries, one must take into account the season of the year when interpreting nutritional data. Although food distribution in the Thailand refugee camps may have varied with political and military circumstances, but not agricultural seasons, we were unable to measure such fluctuations in this study. In industrialized countries, like the FRG such seasonal effects might occur among seasonally-employed migrant agricultural workers, but would be unexpected

unless economic cycles produced severe fluctuations in unemployment.

5.3.9 PSYCHOLOGICAL STRESS

The stress of fleeing political and economic hardship in their homeland, the uncertainties during their refugee period in Thailand, and the marked differences in language, culture, food, climate, architecture, work, etc., between Laos and the FRG, would be expected to have a major impact on the mental health of the refugees studied here. Although assessing mental health was beyond the scope of this study, one study in the U.S.A. reported that 10% of Indochinese refugees had some psychiatric abnormality or disorder (Erickson, 1980).

The relationship, however, between psychological stress and nutritional status has not yet been firmly demonstrated, although growth rates were retarded of infants deprived of their mothers (Patton, 1963) or sent to orphanages (Acheson and Archer, quoted by Topp, 1970).

5.4 ANTHROPOMETRY

Anthropometry is the measurement of the physical dimensions, proportion and the gross composition of the human body. It includes measurements such as stature (supine length or standing height), weight, the circumference of the chest, head, or arm, the thickness of subcutaenous skinfolds, and the colour of skin, hair and eyes. It may be performed on living persons, cadavers, and with some exceptions, on skeletons.

5.4.1 INDICATORS OF NUTRITIONAL STATUS

The physical dimensions of the body are much influenced by nutrition, particularly in the period of rapid growth of early childhood (Jelliffe, 1966). Anthropometry is thus one method used to detect malnutrition, which is defined as disordered nutrition, such as overnutrition (obesity) or undernutrition due to insufficient intake of energy, protein, or other essential nutrients (e.g., vitamins). Other methods of nutritional assessment include medical examination for characteristic physical signs and symptoms of

nutritional disorders, and biochemical assays of bodily fluids.

5.4.2 HISTORY

The first major uses of anthropometry to assess nutritional status were studies of army conscripts and English children in workhouses in the early 1800s (Martorell, 1976). The workhouse studies showed that poverty, poor nutrition and disease were associated with short stature. More recently, anthropometric measurements were used to demonstrate great reductions in weight and height of school children in Paris during and after World War II when diets were very limited (Jelliffe, 1966). Anthropometry also has documented progressive increases in the stature and weight of children and adults in North America, Japan and Jamaica over the past hundred years. Other fields which use anthropometry are physical anthropology, genetics, and forensic medicine.

5.4.3 TECHNIQUE

The methods and measurements employed in anthropometry vary greatly in number and complexity and very much depend on the purpose and objectives of the particular survey or study. According to International agreement for the unification of anthropometrie measurements of living subjects, which was held in Geneva 1912, the general principles of measurement and detailed definitions of 49 measurements were defined. It was agreed that the measurement should be made on the left side of the body. The major surface measurements, landmarks and equipments for each measurement was described in details by Cameron (1978).

However anthropometry for nutritional assessment requires relatively simple techniques and inexpensive and uncomplicated equipment; scales to measure weight, flexible tapes to measure circumference, and tapes fixed to posts or boards to measure stature (supine length or standing height).

The actual measurements to be taken for nutritional anthropometry will depend on the type of nutritional conditions to be investigated, the speed with which findings

are needed, the age groups of interest, and the availability of trained personnel, support facilities, and financing. For example, in a well-financed study of obesity in a developed country, over a period of months or years one might measure height, weight, skinfold and arm circumference of adults to estimate body fat, and compare the findings with biochemical or pathologic analyses of body tissues. In contrast, in a drought emergency one might need to know which regions need food supplementation the most, and thus one might carry out a rapid survey of weight and height measurements only of children less than 5 years of age, which is the age group which is usually first affected in a famine. If time is very short, only arm circumferences might be measured as a rough guide to nutritional status.

5.4.4 LIMITATIONS

Anthropometry, although simple, is subject to measurement errosr (Zerfas, 1977). Knott (1941) quoted by Cameron (1978) devided errors into two sorts: "accidental" and "technical". The former covers such things as misreading the instrument and and misrecording of a correctly read dimension. The latter refers to such definitions of landmarks, errors in locating properly described landmarks, bad subject positioning and application of incorrect pressure. To avoid this, each subject must be measured in a careful standardized manner by well-trained personnel.

Gavan (1950) quoted by Cameron (1978) suggested, in any growth study the smallest number of the most experienced anthropometrists should be used and the landmarks upon which they depend should be well defined and/or easily located.

Triceps skinfold is more prone to error than other measurements (Bray, 1978). This is because it must be done at the precise mid-point of the left upper arm, and must be read within two seconds of applying the calipers (before the fat is additionally compressed). This may be difficult in struggling, non-cooperative children. Moreover, edema (abnormal body swelling, see section 5.5.1.3) may interfere, and variable compressibility of fat in infants may give

inconsistent results. Averaging three measurements has been suggested to minimize some of these problems (Gray, 1980). Finally, ethnic and individual difference in the distribution of body fat tissue and muscle makes difficult comparison to reference standards (Brozek, 1956; Keys, 1973).

However one has also to keep in mind that strictly speaking, anthropometry does not specifically assess protein - calorie malnutrition. Genetic and disease factors that are not yet quantifiable are additional influences on growth and body composition, Keller (1976).

5.4.5 STANDARDS OF REFERENCE

Although actual measurements should always be summarized mathematically and reported in anthropometric surveys, it is important to relate these measurements to that of a reference population.

The question of which population provide the most relevant "reference" for groups of undernourished children in developing countries has always been debated. The most frequently used reference standards are the "Harvard standards" (Stuart, 1959) and the "British standards" (Tanner, 1966). The Havard standards were obtained from a study of well-nourished Caucasian children in Boston in the 1930s. The British standard were obtained from healthy British children in London (Tanner, 1966).

However, some have considered the use of a reference standard derived from a developed country population was not appropriate and felt that these references were too high standards (Eusebio, 1981). In order to be more realistic about potential growth achievements of any population, a development of local standard has been proposed (Goldstein, 1980).

On the other hand, the collection of data to derive local reference standards is nevertheless difficult, time-consuming and expensive undertaking which few developing countries could afford it. Besides the use of local standards is complicated by the fact that improvement in nutrition in the country

will change the "standard" itself.

The observations that well-nourished children in developing countries grow in much the same way as their counterparts in the developed world (Graitcer, 1981), and that the ethnic difference in growth is minimal (Habicht, 1974) have lent support to the use of a single international growth standard for all.

The use of NCHS/CDC/WHO standards have been recommended and recognized to be the most appropriate reference standard for the time-being.

The use of a single growth reference permits the international comparison of nutritional conditions in various countries. The use of one reference for all countries also permits the measurement of the impact of various environmental factors, such as famine, poverty, and infection on the overall growth of preschool children (Graitcer, 1981).

5.5 ANTHROPOMETRIC INDICATORS OF MALNUTRITION

There has been much discussion on which of anthropometric indicator is most appropriate in different populations, at different times, or diagnostic of different nutritional situations. Generally, weight, height, arm circumference, triceps- and subscapular skinfold thickness are considered to be the most sensitive parameters in assessement of the under-five nutritional status.

5.5.1 WEIGHT-FOR-AGE (W/A)

Body weight reflects a complex summation of many physical processes, and changes in relation to age. Reduction in weight, especially among children, is the most sensitive indicator and usually the earliest sign of growth failure or inadequate energy intake in acute episodes of malnutrition. Marasmus is a non-specific term for undernutrition due to inadequate calories, and is defined as less than normal weight, using cutoffs that vary with different investigators. Various systems of classification have been developed to classify W/A.

5.5.1.1 GOMEZ CLASSIFICATIONS

In the early 1950s, Gomez (1955) devised a classification to detect malnutrition among hospitalized children. The child's weight was expressed as a percentage of the average weight found in a reference population of similar age. The reference data were based on "Harvard Standards."

In the Gomez classification, children weighing from 90% to 76% of that expected for age are designated to have first degree (mild) malnutrition, from 75% to 60% to have second degree (moderate) malnutrition, and those weighing less than 60% to have third degree (severe) malnutrition (Gomez, 1956).

A similar classification to Gomez' was proposed by Jelliffe (1966), using the same Harvard standards. He designated four levels of malnutrition: 90-80% 79-70%, 69-60%, and less than 60% of the expected weight for age.

The use of such classifications based on the Harvard standards is now obsolete (Gueri, 1980; WHO, 1983).

5.5.1.2 S.D.-SCORE AND NCHS STANDARDS

In 1977, Waterlow introduced the Standard Deviation score (S.D.-score), also referred to as the Z-score. This measure expressed weight and height as a deviation of the individual's weight in units of the standard deviation from the median weight of a new reference population of similar age to the individual (Waterlow, 1977). The development of S.D.-score, using the same reference population was meant to make international comparison of anthropometric measurement possible, taking into account that the influence of genetic factors at preschool age is minimal. Hence the average S.D.-scores (W/A, H/A, W/H) for children in specific age and sex groups can be calculated. Such average can be used for comparing the overall position of different groups.

Data for the new reference population were assembled by the U.S. National Center for Health Statistics (NCHS, 1976), with additional statistical tasks carried out by the U.S. Centers for Disease Control. These

reference standards were felt to best meet the criteria of a WHO working group for a universal reference population (Waterlow, 1977), and have been adopted by the World Health Organization for international use (WHO, 1983). They are often referred to as the NCHS/CDC/WHO reference standards. Details of calculations of S.D.-scores W/A, H/A, and W/H see section 3.5.1.1, 3.5.1.2, and 3.5.1.3 respectively.

5.5.1.3 LIMITATIONS

W/A is misleading in the presence of kwashiorkor. Kwashiorkor is a nutritional disorder due to protein deficiency in the presence of adequate calories (Waterlow, 1972). It is usually characterized by edema, which is the swelling of the body due to the collection of abnormal amounts of fluid in the tissues, and sometimes by ascites, which is the collection of abnormal amounts of fluid in the abdominal cavity. This fluid comes from the bloodstream, and is replaced there by drinking water. This extra fluid increases body weight, even though body muscle and fat may be the same or lower than normal.

In 1969, the Wellcome working party group (Wellcome, 1970) suggested that the presence of edema be determined in nutritional assessment to detect kwashiorkor, since W/A may be normal. Kwashiorkor and marasmus may coexist as "marasmic kwashiorkor", if edema is present and W/A is still low (Cooper, 1982). No kwashiorkor was detected in any of the Laotian refugees sampled in this study.

5.5.2 HEIGHT-FOR-AGE (H/A)

Height (measured standing) or length (measured supine) reflects linear growth. It is much less sensitive than weight to short-term nutritional fluctuations, but is a good indicator of long-term nutritional status and deficiencies in the past. Chronic nutrient inadequacy causes a retardation in linear growth among children (Rea, 1971). The extent that height is less than that expected for age is felt to represent the duration of malnutrition (Waterlow, 1972). As with W/A, height-for-age (H/A) is used to

compare an individual's height to a reference population of the same age as the individual in question.

Analyzing W/A and H/A together can provide useful information. Low W/A in the presence of normal H/A (or W/A disproportianally lower H/A) suggests acute malnutrition in a population that was previously well-nourished. Low W/A with equally low H/A suggest long-term malnutrition, with or without recent malnutrition (distinguished using W/H, see below). Normal W/A in the presence of low H/A would be an unusual finding, although it might occur theoretically in a population chronically malnourished in the past, with recent overnutrition (obesity).

5.5.2.1 GOMEZ CLASSIFICATION

As with W/A, Gomez classified the height of children according to the percent of the mean height of his reference population of similar age, using cutoffs of 90-76%, 75-60%, and less than 60% (Gomez, 1955). Jelliffe used cutoff of 90-80%, 79-70%, 69-60%, and less than 60% (Jelliffe, 1966).

5.5.2.2 S.D.-SCORE

As with W/A, the best current measure of H/A is the S.D.-score, calculated as in the W/A example above (see sections 3.5.1.2 and 5.5.1.2). The NCHS/CDC/WHO reference standards are used.

5.5.2.3 STUNTING

Stunting ("short for age") or a failure to develop one' full genetic potential for physical growth (Waterlow, 1978), is defined as an S.D.-score for H/A that is less than -2 (Waterlow, 1977). In some studies, S.D.-score cutoffs for stunting of -2.5 and -3 have been used (Schelp, 1982). An S.D.-score of -2 usually corresponds to a height that is about 90% of the median height for a given age. The atiology of stunting is unclear though many felt it was a result of chronic malnutrition.

5.5.3 WEIGHT-FOR-HEIGHT (W/H)

In many developing countries it is impossible or difficult to determine the age of study subjects. The weight-for-height (W/H) indicator is a measure of nutritional status which is independent of age (Waterlow, 1973). In essence, it measures whether one's weight, which is most sensitive to recent malnutrition, is proportional to one's height, no matter how stunted one may be. As such, it is a more direct measure of acute malnutrition than W/A, since it is not affected by past periods of acute or chronic malnutrition.

5.5.3.1 S.D.-SCORE

As with W/A and H/A, W/H is expressed as a score which indicates the deviation of the individual's weight from the median weight of the reference population of similar height (instead of age). Once again, the new NCHS/CDC/WHO reference population is used.

5.5.3.2 PERCENT OF MEDIAN

For convenience in field work, where calculation of W/H S.D.-score is cumbersome, it has been suggested that each individual's weight could be expressed as a simple percentage of the reference median weight for the reference population of his height. This is because certain cutoffs of percentage corresponded roughly to various S.D.-scores. For example, 120% of the median W/H is about +2.0 S.D.-score, 90% is about -1.0 S.D. -score, and 80% is about -2.0 S.D.-score (Waterlow, 1977).

5.5.3.3 WASTING

Wasting, or undernutrition, is usually defined as an S.D.-score on W/H less than -2, or a weight that is less than 80% of the median weight for a given height (Waterlow, 1977). It is a quantitative definition which corresponds to the term marasmus, which is a clinical diagnosis based on qualitative criteria. Wasting is a result of insufficient nutrient consumption for growth or physiological needs and/or inability to utilize ingested food.

5.5.4 MID-UPPER-ARM CIRCUMFERENCE (MUAC)

Mid-upper-arm circumference (MUAC) measures the bone, muscle, and fat components of the arm. Since bone size for a given age group is regarded to be relatively constant (Jelliffe, 1966), MUAC is thus an indirect index of both protein (muscle) and energy (fat) reserves in the body. MUAC between the ages of 1 (median 15.5 cm) and 4 (17 cm) changes very little, and is thus relatively age independent (Cooper, 1982). Consequently, since the technique of measuring MUAC is simple, it is an anthropometric measure that is popular for surveying children of appropriate ages under field conditions where time is short and age may be time-consuming or impossible to determine (Jellifee, 1969).

MUAC has been shown to be associated with weight and W/H (Alleyne, 1977). Arbitrary cutoff points of MUAC less than 12.5 cm (Trowbridge, 1979a) and 13.5 cm (Anderson, 1979) have been used to classify a child aged 1 to 4 as malnourished. The cutoff point at 12.5 was reported to have included all children whose weight for age were less than 80% of reference standard (Shakir, 1974). Such cutoffs, however, do not correspond to any specific S.D.-score on W/H or W/A.

According to our study, MUAC was however significantly correlated with age (Table 4), the use of any arbitary cutoff point of MUAC should therefore be considered carefully.

5.5.5 SKINFOLD THICKNESS

More than half of the total body fat is subcutaneous fat (Bastow, 1982). Skinfold thickness is the measurement of the thickness of subcutaneous fat, and represents an estimate of the calorie reserves stored in body fat. There is a high correlation (0.85 to 0.90) between skinfold thickness and direct measurement of the width of subcutaneous fat by x-ray (Tanner, 1962). Because of its simple technique (see section 3.3.2.4), measurement of skinfold at the left triceps and left subscapular areas have been widely used to assess obesity and malnutrition in children and adults.

Individual skinfold measurements are compared to the value of a reference population of the same age group (Frisancho, 1974; Reinken, 1980a). Haider (1984) suggested that skinfold values between the 40th and 35th percentile of the reference standard indicate mild fat (and energy) depletion. Between the 35th and 25th percentile would indicate moderate depletion, and less than the 25th percentile would indicate severe depletion.

Because increases with age of triceps skinfold are less marked than the corresponding increases in total body fat, it has been suggested that arm fat area (see 5.5.6) is a better index of body fat than triceps skinfold (Frisancho, 1981).

5.5.6 ARM MUSCLE AREA AND ARM FAT AREA

Cross-sectional arm muscle area and arm fat area are derived from arm circumference and triceps skinfold (see section 3.5.2), as separate measures of body protein reserves and fat reserves, respectively (Frisancho, 1981). The use of these indicators permits more precise estimations of muscle mass and fat reserves than MUAC or triceps skinfold thickness alone. It also helps to distinguish the cause of malnutrition, whether it is due to energy or protein shortage.

5.6 ANTHROPOMETRIC INDICATORS OF SOCIO-ECONOMIC WELL-BEING

Anthropometric assessment at the population level has been recommended by the FAO and WHO as indirect indicators for monitoring social and economic progress in the delveloping countries. For example if increasing income is the impact of an agriculture or rural develpment project, the result may be anthropometric improvement through increasing the family' capacity to purchase more food. On the other hand, when the impact of agricultural improvement means increasing work load and energy expenditure and lack of time for taking care and preparing food for children, such an improvement on nutritional status is very unlikely to be seen. If improvement of sanitation facilities or increasing the level of nutritional edcucation of mothers is to be

successful, they should have also an impact on improving of nutritional status of their children. However since anthropometric indicators are influenced by many environment factors, assessing them has to take into account these factors.

6. FIGURES

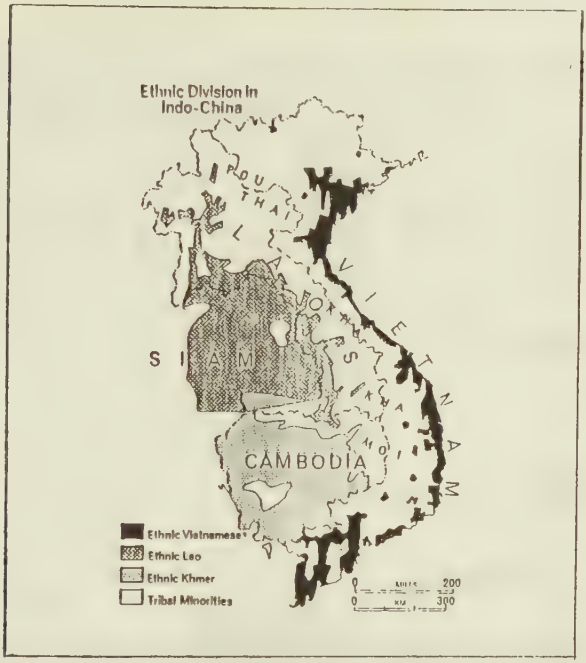
Fig.1 Map of Laos, Political Boundaries

Source: Halpern, 1964b

Fig.2 Map of Laos, Ethnic Groups

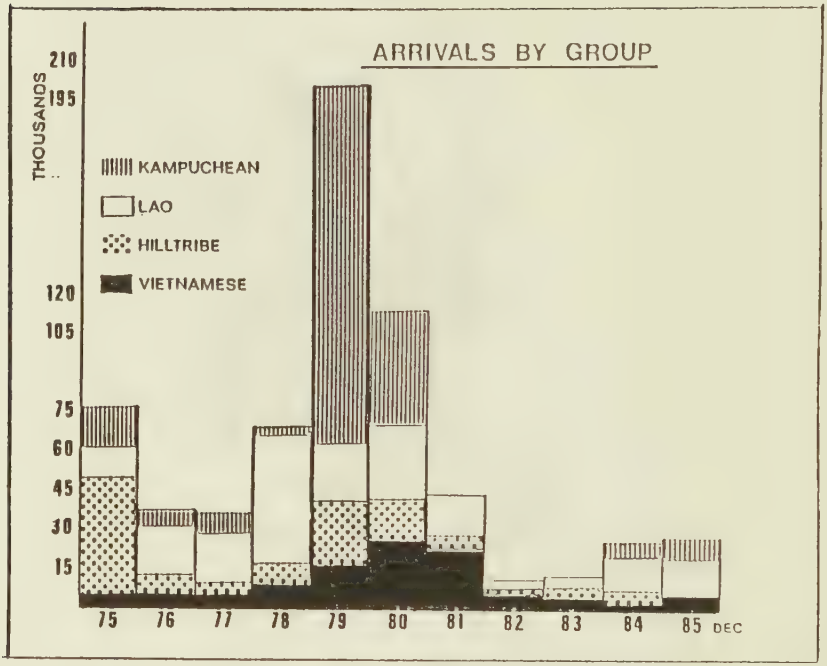
Source: Adams, 1970

Fig.3 Map of Southeast Asia, Ethnic Groups



Source: Toye, 1968

Fig.4 Indochinese Refugee Arrivals in Thailand by Group and by Year*



* Source: UNHCR, 1985

Fig.5 Map of the Federal Republic of Germany, indicating political boundaries and 17 cities, where this study was taken.

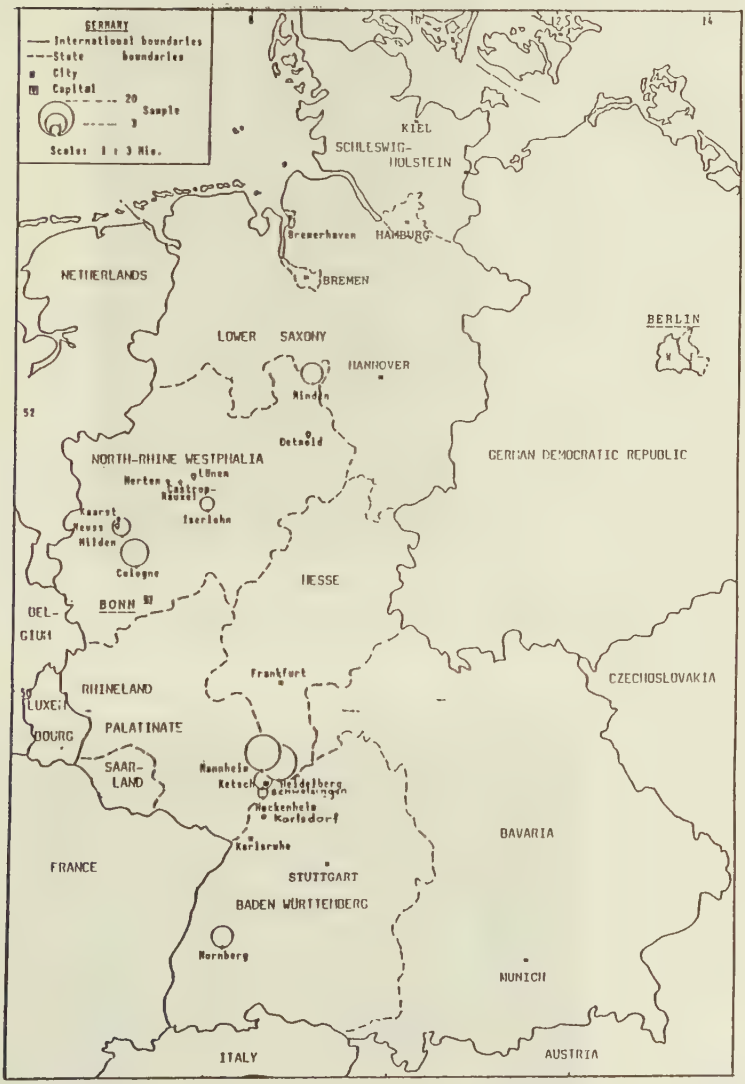


Fig.6 Weight measurement

Fig.7 Length measurement

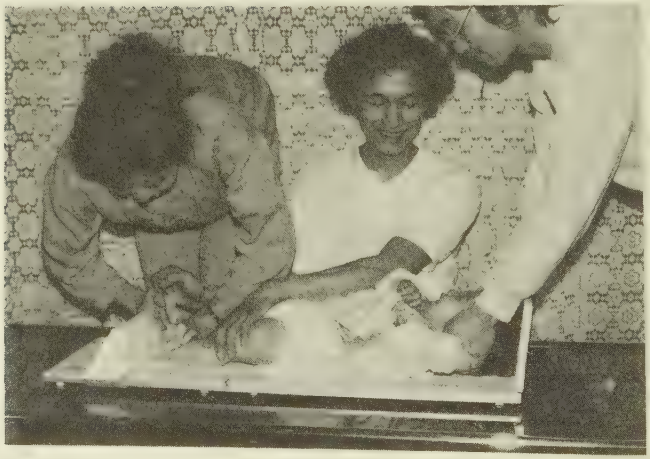


Fig.8 Arm circumference measurement

8a. Identifying the mid-point between acromion and olecranon.

8b. Mid-upper arm circumference measurement

Fig.9 Triceps skinfold measurement

Fig.10 Subscapular skinfold measurement

Fig. 11a
Weight by Age, of Female Lao Refugee children in Thailand in 1981 and in the Federal Republic of Germany (FRG) in 1982, with reference standards.

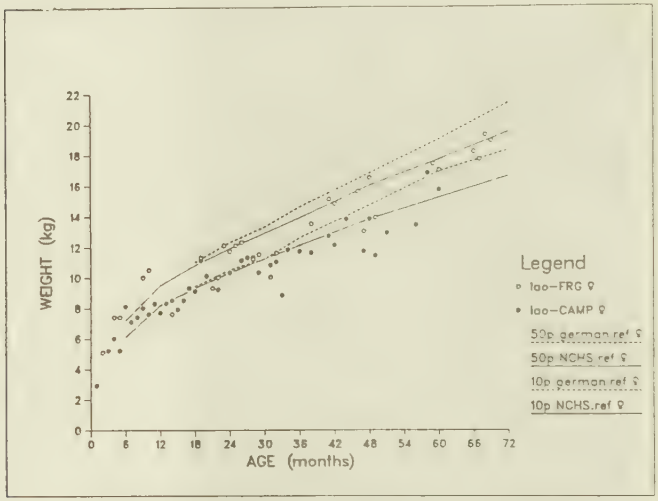


Fig. 11b
Weight by Age, of Male Lao Refugee children in Thailand in 1981 and in the Federal Republic of Germany (FRG) in 1982, with reference standards.

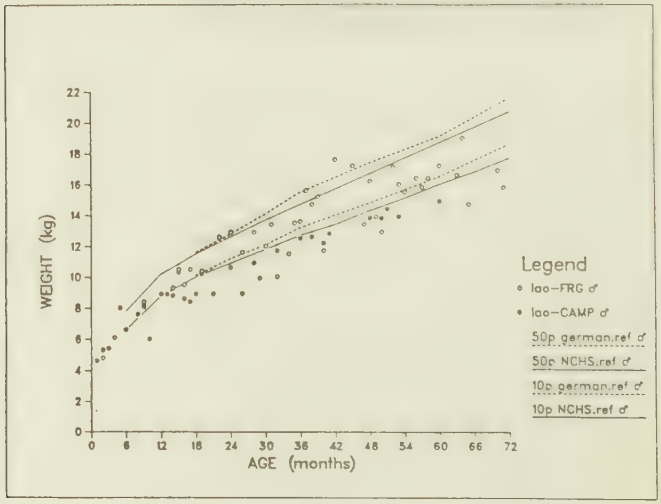


Fig. 12a
Height by Age, of Female Lao Refugee children in Thailand in 1981 and in the Federal Republic of Germany (FRG) in 1982, with reference standards.

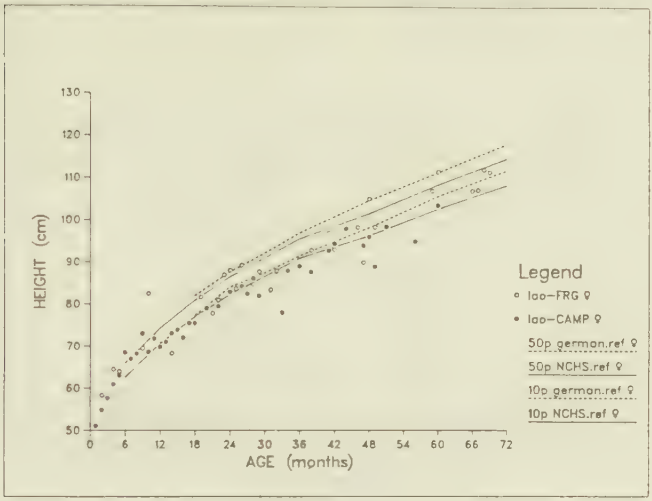


Fig. 12b
Height by Age, of Male Lao Refugee children in Thailand in 1981 and in the Federal Republic of Germany (FRG) in 1982, with reference standards.

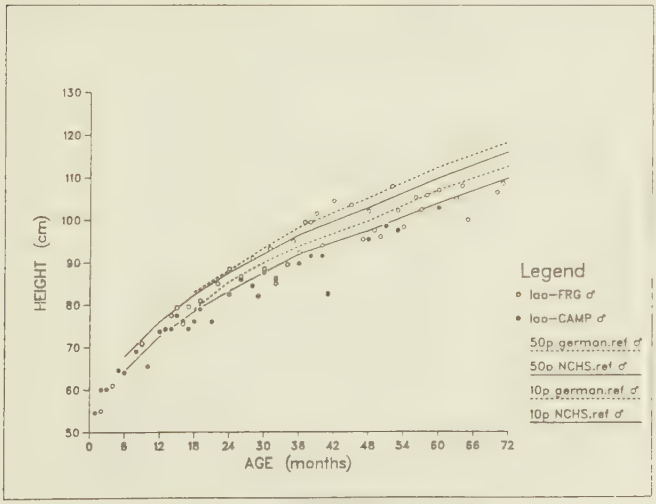


Fig. 13a
Cumulative Frequency Distribution of S.D.-score for Weight-for-Age for Lowland Lao Refugee Children in Thailand Camps in 1981 and in the Federal Republic of Germany (FRG) in 1982.

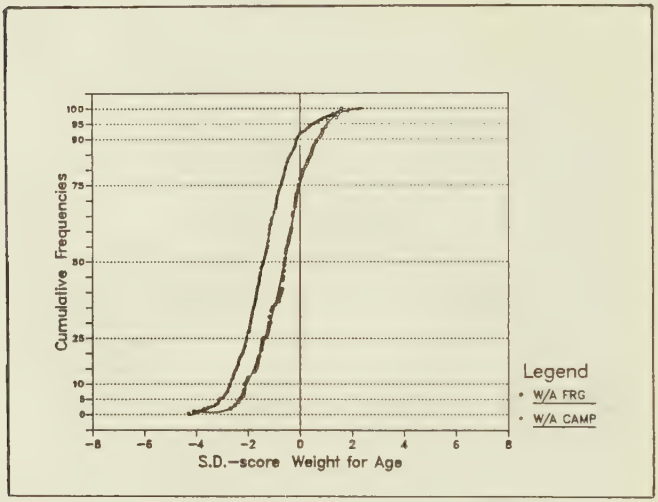


Fig. 13b
Cumulative Frequency Distribution of S.D.-score for Height-for-Age for Lowland Lao Refugee Children in Thailand Camps in 1981 and in the Federal Republic of Germany (FRG) in 1982.

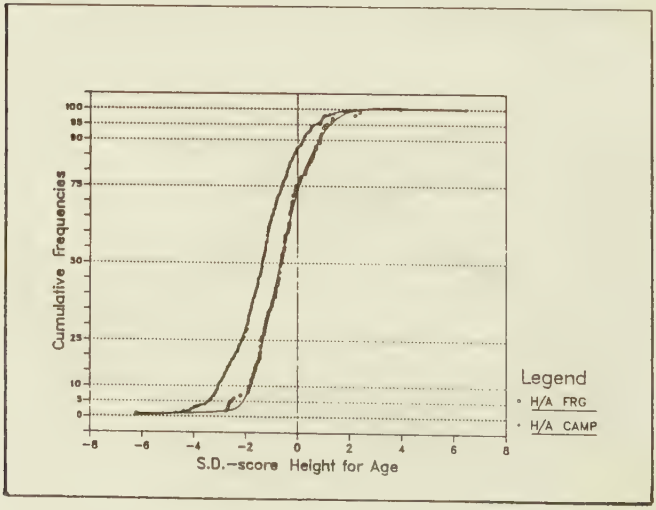


Fig. 13c
Cumulative Frequency Distribution of S.D.-score for Weight-for-Height for Lowland Lao Refugee Children in Thailand Camps in 1981 and in the Federal Republic of Germany (FRG) in 1982.

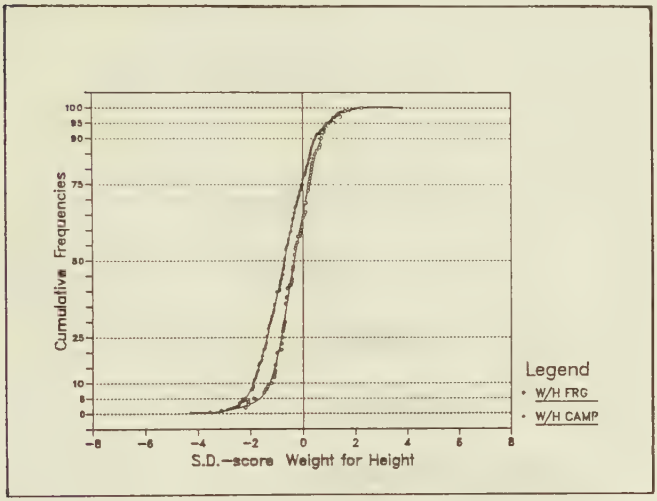


Fig. 14
Mean S.D.-scores (Z-scores) of Anthropometric Indices, by sex, of Lao Refugee children in Thailand in 1981 and in the Federal Republic of Germany (FRG) in 1982, and German Dortmund Children population, based on the NCHS/WHO Reference Standards.

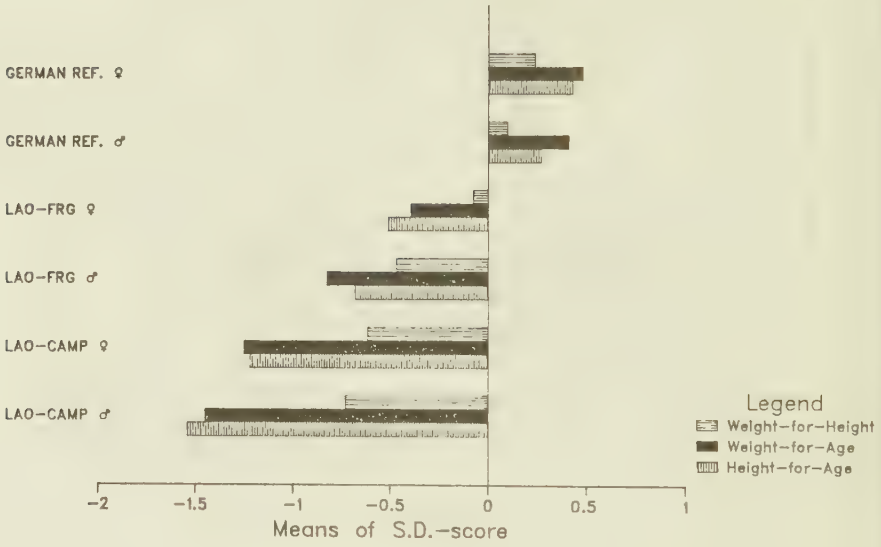


Fig. 15a
Mean S.D.-scores by age of subjects in Thailand camps, sex combined.

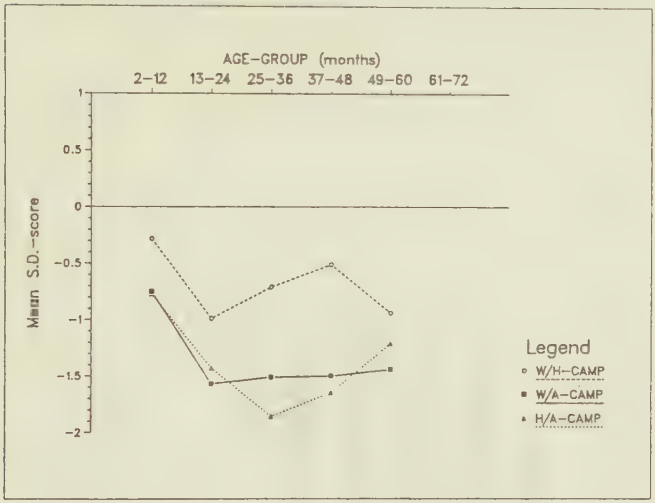


Fig. 15b
Mean S.D.-scores by age of subjects in the FRG, sex combined.

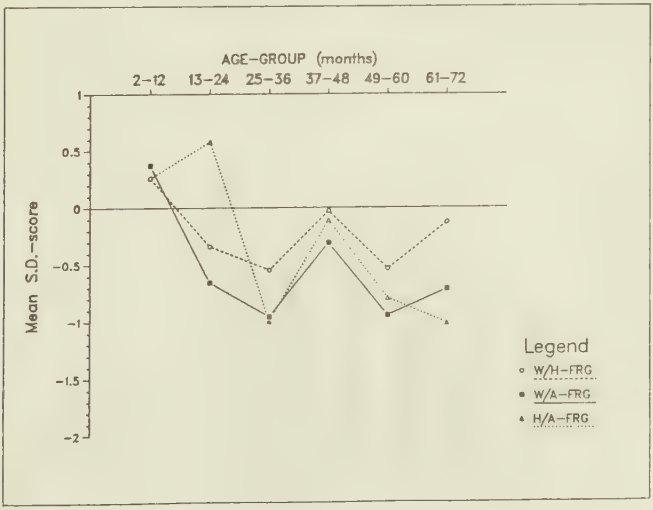
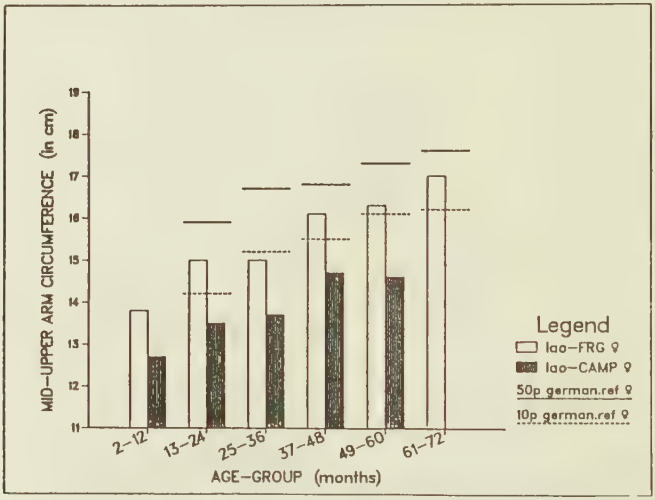
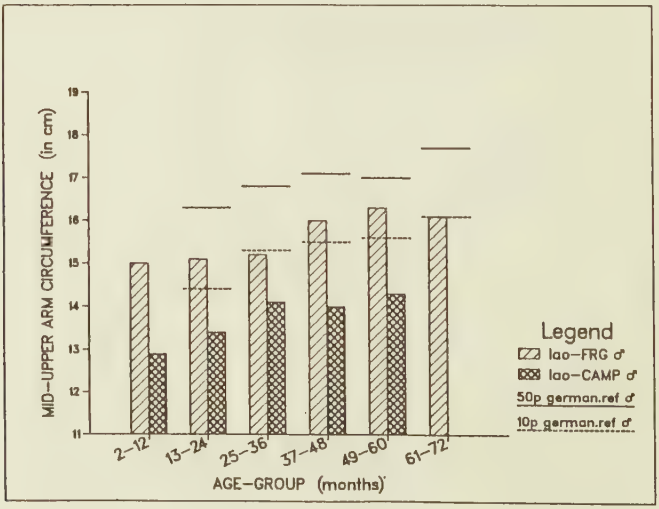


Fig. 16
Median Mid-upper Arm Circumference of Lao Refugee children in Thailand in 1981 and in the Federal Republic of Germany (FRG) in 1982, compared to the German Dortmund Children reference populations.*

16a Girls



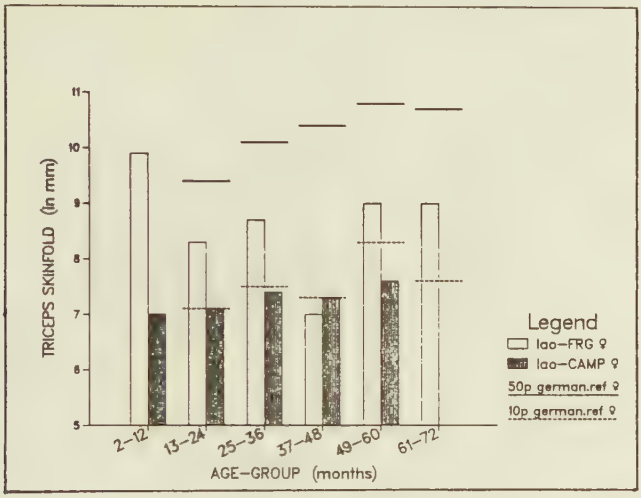
16b Boys



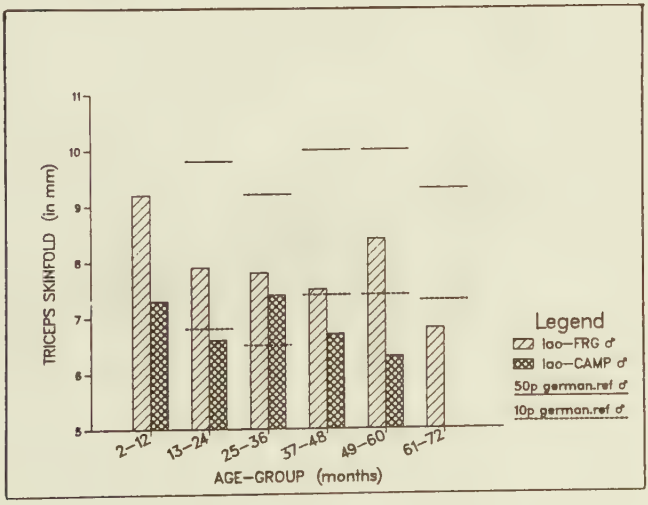
* See reference Reinken, 1980b.

Fig. 17
Triceps-skinfold Thickness of Laotian Refugee Children in Thailand camps in 1981 and in the Federal Republic of Germany (FRG) in 1982, compared to German Dormund Children Population.*

17a Girls



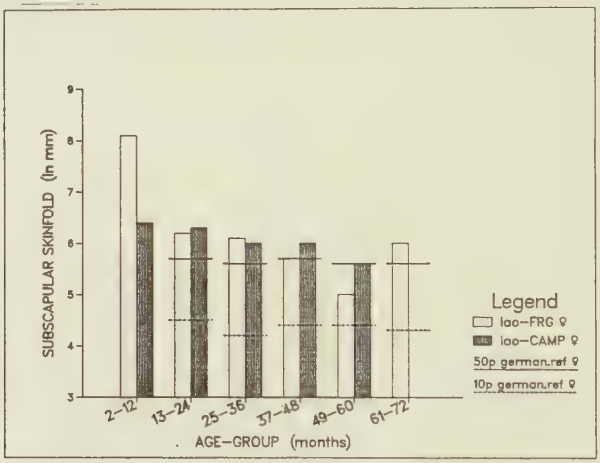
17b Boys



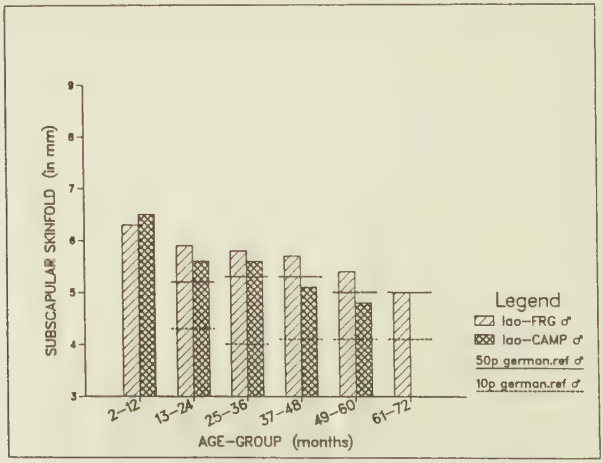
* See reference Reinken, 1980a.

Fig. 18
Subscapular-skinfold Thickness of Laotian Refugee Children in Thailand camps in 1981 and in the Federal Republic of Germany (FRG) in 1982, compared to German Dormund Children Population.*

18a Girls



18b Boys



* See references Reinken, 1980a.

Fig. 19
Median Arm Muscle Area, by Age-group, and by Sex, Laotian Refugee Children in Thailand camps in 1981 and in the Federal Republic of Germany (FRG) in 1982.

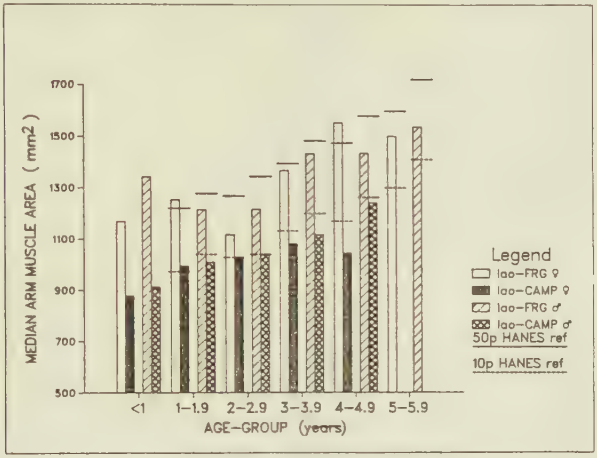
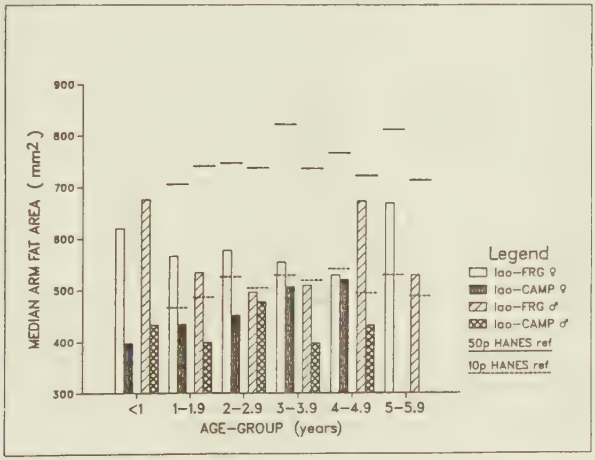


Fig. 20
Median Arm Fat Area, in Square mm, by Age-group, and by Sex, Laotian Refugee Children in Thailand camps in 1981 and in the Federal Republic of Germany (FRG) in 1982.



7. TABLES

Table 1a.

Anthropometric Measurements of Lowland Laotian Refugees in Thailand Refugee Camps (1981) and Federal Republic of Germany (1982), by Age-group, Girls only (Mean + S.E.).

AGE	SAMPLE SIZE		WEIGHT (kg)		HEIGHT (cm)	
(mos)	Camps	FRG	Camps	FRG	Camps	FRG
2-12	38 (24%)	6 (13%)	6.7 (0.3)	7.6 (1.0)	64.6 (1.1)	66.2 (3.7)
13-24	40 (26%)	14 (30%)	9.7 (0.3)	10.5 (0.5)	79.3 (1.0)	81.4 (2.1)
25-36	34 (22%)	10 (21%)	11.3 (0.2)	11.6 (0.3)	86.9 (1.0)	86.2 (1.0)
37-48	25 (16%)	6 (13%)	13.3 (0.3)	14.8 (0.5)	94.8 (1.0)	96.1 (2.1)
49-60	19 (12%)	4 (9%)	15.2 (0.4)	15.5 (1.1)	103.7 (2.1)	103.8 (3.4)
61-72	0	7 (15%)		18.5 (0.6)		109.7 (1.7)
TOTAL	156 (100%)	47 (100%)				

AGE	ARM CIRCUMFERENCE (cm)		SKINFOLD THICKNESS			
			Triceps (mm)		Subscapular (mm)	
(mos)	Camps	FRG	Camps	FRG	Camps	FRG
2-12	12.6 (0.2)	13.7 (0.5)	7.2 (0.2)	9.7 (1.0)	6.8 (0.3)	8.1 (0.4)
13-24	13.4 (0.1)	15.0 (0.4)	6.8 (0.2)	8.5 (0.6)	6.3 (0.2)	6.3 (0.3)
25-36	13.8 (0.1)	14.8 (0.3)	7.5 (0.2)	8.8 (0.4)	5.9 (0.2)	6.1 (0.4)
37-48	14.4 (0.2)	16.4 (0.3)	7.7 (0.2)	9.0 (1.1)	6.2 (0.2)	6.7 (0.8)
49-60	14.7 (0.1)	16.2 (0.4)	7.4 (0.2)	9.1 (1.6)	5.7 (0.2)	6.0 (0.8)
61-72		16.9 (0.3)		9.6 (1.2)		5.9 (0.4)

Camps = Panat Nikhom and Lumpini Transit Camps, Thailand
FRG = Federal Republic of Germany

Table 1b.

Anthropometric Measurements of Lowland Laotian Refugees in Thailand Refugee Camps (1981) and Federal Republic of Germany (1982), by Age-group, Boys only (Mean + S.E.).

AGE	SAMPLE SIZE		WEIGHT (kg)		HEIGHT (cm)	
(mos)	Camps	FRG	Camps	FRG	Camps	FRG
2-12	31 (19%)	4 (7%)	7.2 (0.3)	6.9 (1.1)	66.4 (1.3)	64.5 (3.9)
13-24	43 (27%)	10 (18%)	9.6 (0.2)	10.9 (0.4)	78.5 (0.7)	81.5 (1.4)
25-36	34 (21%)	11 (20%)	12.0 (0.3)	12.3 (0.4)	88.3 (0.8)	90.0 (1.0)
37-48	35 (22%)	10 (18%)	13.7 (0.3)	15.2 (0.5)	94.8 (0.9)	100.1 (1.3)
49-60	16 (10%)	15 (27%)	14.8 (0.4)	16.0 (0.3)	101.8 (1.3)	103.5 (1.0)
61-72	0	5 (9%)		16.6 (0.7)		105.6 (1.5)
TOTAL	159 (100%)	55 (100%)				

AGE	ARM CIRCUMFERENCE (cm)		SKINFOLD THICKNESS			
			Triceps (mm)		Subscapular (mm)	
(mos)	Camps	FRG	Camps	FRG	Camps	FRG
2-12	13.0 (0.2)	14.5 (1.0)	7.3 (0.3)	9.3 (0.7)	6.7 (0.3)	6.4 (0.4)
13-24	13.4 (0.1)	15.2 (0.3)	6.7 (0.1)	7.8 (0.6)	5.9 (0.1)	6.4 (0.4)
25-36	14.2 (0.1)	15.0 (0.3)	7.3 (0.2)	8.2 (0.5)	5.7 (0.2)	5.6 (0.2)
37-48	14.2 (0.1)	16.1 (0.3)	6.9 (0.2)	7.7 (0.5)	5.3 (0.2)	6.1 (0.5)
49-60	14.3 (0.2)	16.4 (0.1)	6.4 (0.3)	8.9 (0.6)	5.0 (0.2)	5.6 (0.2)
61-72		16.2 (0.4)		8.1 (1.6)		4.8 (0.3)

Camps = Panat Nikhom and Lumpini Transit Camps, Thailand
FRG = Federal Republic of Germany

Table 2a.

Mean S.D.-score of Anthropometric Indices for Lowland Laotian Refugee Children, Thailand Refugee Camps (1981) and Federal Republic of Germany (1982), by Age, Girls Only

Age (mos)	Sample Size+		Mean S.D.-scores (+/-SD)					
			Weight/Age		Height/Age		Weight/Height	
	Camps	FRG	Camps	FRG	Camps	FRG	Camps	FRG
2-12	38 (24%)	6 (13%)	-0.77 (1.31)	+1.07 (0.56)	-0.76 (1.18)	+0.97 (1.56)	-0.22 (1.27)	+0.53 (1.14)
13-24	40 (26%)	14 (30%)	-1.36 (1.21)	-0.73 (1.47)	-1.18 (1.39)	-0.72 (1.99)	-0.89 (0.86)	-0.34 (0.89)
25-36	34 (22%)	10 (21%)	-1.54 (0.99)	-0.80 (1.00)	-1.85 (1.45)	-1.01 (1.06)	-0.71 (0.82)	-0.30 (0.82)
37-48	25 (16%)	6 (13%)	-1.44 (0.88)	-0.36 (0.69)	-1.38 (1.15)	-0.72 (1.22)	-0.51 (0.94)	+0.58 (0.58)
49-60	19 (12%)	4 (9%)	-1.17 (0.87)	-0.76 (0.92)	-0.90 (2.03)	-0.33 (0.96)	-0.81 (1.08)	-0.71 (0.64)
61-72	0	7 (15%)		-0.22 (0.68)		-0.58 (0.93)		+0.14 (0.25)
All ages TOTAL	156 (100%)	47 (100%)	-1.25 (0.09)	-0.40 (0.17)*	-1.22 (0.11)	-0.51 (0.22)*	-0.62 (0.08)	-0.08 (0.12)*

Camps = Panat Nikhom and Lumpini Transit Camps, Thailand
FRG = Federal Republic of Germany

+ Parentheses contain proportion of each age group among the total sample in each location, in percent rounded to nearest whole number.

* Mean S.D.-scores between girls in Camps and FRG significantly different by t-test for Weight/Age ($p<.0001$), Height/Age ($p<.002$), and Weight/Height ($p<.0002$).

Table 2b.

Mean S.D.-score of Anthropometric Indices for Lowland Laotian Refugee Children ,Thailand Refugee Camps (1981) and Federal Republic of Germany (1982), by Age,
Boys Only

Age (mos)	Sample Size+		Mean S.D.-scores (+/-SD)					
			Weight/Age		Height/Age		Weight/Height	
	Camps	FRG	Camps	FRG	Camps	FRG	Camps	FRG
2-12	31 (19%)	4 (7%)	-0.73 (1.27)	-0.69 (1.36)	-0.65 (1.18)	-0.81 (0.37)	0.35 (1.03)	-0.14 (2.08)
13-24	43 (27%)	10 (18%)	-1.76 (0.92)	-0.56 (0.74)	-1.66 (1.02)	-0.39 (0.69)	-1.09 (0.88)	-0.35 (0.68)
25-36	34 (21%)	11 (20%)	-1.49 (0.87)	-1.11 (0.83)	-1.87 (1.19)	-1.00 (0.89)	-0.70 (0.90)	-0.77 (0.88)
37-48	35 (22%)	10 (18%)	-1.55 (0.87)	-0.28 (0.97)	-1.84 (1.27)	+0.27 (1.20)	-0.52 (0.93)	-0.39 (0.66)
49-60	16 (10%)	15 (27%)	-1.77 (0.68)	-1.00 (0.52)	-1.58 (1.05)	-0.92 (0.70)	-1.09 (0.79)	-0.50 (0.48)
61-72	0	5 (9%)		-1.40 (0.81)		-1.64 (0.67)		-0.50 (0.73)
ALL AGES	159 (100%)	55 (100%)	-1.45 (0.08)	-0.82 (0.11)*	-1.54 (0.09)	-0.68 (0.13)*	-0.74 (0.08)	-0.47 (0.11)*

Camps = Panat Nikhom and Lumpini Transit Camps, Thailand
FRG = Federal Republic of Germany

+ Parentheses contain proportion of each age group among the total sample in each location, in percent rounded to nearest whole number.

* Mean S.D.-scores between boys in Camps and FRG significantly different by t-test for Weight/Age ($p<.0001$), Height/Age ($p<.0001$), and Weight/Height ($p<.02$).

Table 3.

Wasting* and Stunting** among Lowland Laotian Refugee Children, Thailand (1981) and Federal Republic of Germany (1982), by Age.

Age (mos)	Number Studied		Number Wasted/ (% of total)		Number Stunted/ (% of total)	
	Camps	FRG	Camps	FRG	Camps	FRG
2-12	69	10	6 (1.9%)	1 (1.0%)	4 (1.3%)	0
13-24	83	24	12 (3.8%)	0	23 (7.3%)	1 (1.0%)
25-36	68	21	4 (1.3%)	2 (2.0%)	32 (10.2%)	4 (3.9%)
37-48	60	16	4 (1.3%)	1 (1.0%)	19 (6.0%)	1 (1.0%)
49-60	35	19	4 (1.3%)	0	9 (2.9%)	0
61-72		12		0		1 (1.0%)
TOTAL	315	102	30 (9.5%)	4 (3.9%)	87 (27.6%)	7 (6.9%)

* Wasting is defined as ≤ 2 S.D. below median weight-for-height (W/H) of NCHS/WHO reference standards.

** Stunting is defined as ≤ 2 S.D. below median height-for-age (H/A) of NCHS/WHO reference standards.

Camps = Panat Nikhom and Lumpini Transit Camps, Thailand
FRG = Federal Republic of Germany

Table 4.

Significant ($p<.05$) Correlation Coefficients among Anthropometric Measurements and Indices for Lowland Laotian Refugee Children, Thailand (1981) and Federal Republic of Germany (1982).

Dependent Variables	INDEPENDENT VARIABLES: AGE Camps / FRG	WEIGHT Camps / FRG	HEIGHT Camps / FRG	ARM_CIRC Camps / FRG	TRICEPS Camps / FRG	SUBSCAP Camps / FRG
Weight	.890 / .899	////////	- / -	- / -	- / -	- / -
Height	.923 / .927	.956 / .968	////////	- / -	- / -	- / -
Arm Circ	.569 / .631	.773 / .799	.650 / .729	////////	- / -	- / -
Triceps	- / -	- / -	- / -	.446 / -	////////	- / -
Subscap	.355 / .342	.262 / -	.376 / .346	- / -	- / -	////////
W/A	- / -	- / -	- / -	.365 / .313	.345 / -	.385 / -
H/A	- / -	- / -	- / -	- / -	- / -	- / -
W/H	- / -	- / -	- / -	.398 / .277	.454 / -	.493 / .387

Camps = Panat Nikhom and Lumpini Transit Camps, Thailand
FRG = Federal Republic of Germany

Arm Circ = Arm Circumference
Triceps = Triceps Skinfold Thickness
Subscap = Subscapular Skinfold Thickness

W/A = Weight-for-Age
H/A = Height-for-Age
W/H = Weight-for-Height

\- = Not significant ($p>.05$).

Table 5.

Feeding History and Correlation with Anthropometric Indices of Lowland Laotian Refugees in the Federal Republic of Germany (FRG) in 1982, by Place of Birth.†

Independent Variables	Mean Age [months](+/-SE) Laos-born (n=35)	FRG-born (n=49)	Significant partial regression coefficient with Anthropometric Dependent Variables W/A	H/A	W/H	Skinfold Thickness Triceps	Subscapular
Complete Weaning	18 (1.2)	9 (1.1)*	-.166 [c]		-.183 [c]	-.203 [b]	-.231 [b]
First Offered:							
Commercial baby food	n.a.	3 (0.3)			-.259 [b]		
Juices	10 (1.1)	4 (0.5)*					-.308 [a]
Vegetables	11 (1.1)	5 (0.8)*			-.168 [b]		-.245 [b]
Cereals	4 (0.4)**	7 (0.7)			-.300 [b]	-.165 [c]	
Fruits	13 (1.0)	9 (0.7)***					-.189 [c]
Meat	9 (0.5)	9 (0.7)	-.237 [b]		-.374 [a]	-.150 [b]	-.286 [b]
Table food	21 (1.2)	10 (1.3)*					-.200 [c]
Multiple R			0.362		0.528	0.447	0.401
F			1.72		4.45	2.88	2.206
Sig.level			0.105		0.000	0.007	0.034
R^2			0.131		0.289	0.200	0.161

† Subjects born in Thailand refugee camps (n=18) excluded from total (see text 4.7).

* Food first offered at a significantly earlier age than other group ($p<.001$), (** = $p<.005$, *** = $p\leq.02$, Mann - Whitney U test)

W/A = S.D.-score (Weight-for-Age)
H/A = S.D.-score (Height-for-Age)
W/H = S.D.-score (Weight-for-Height)

Table 6.

Milk Feeding Practices, Laotian Refugee Children in the Federal Republic Germany (FRG), 1982

	Number* Reported Receiving Specified Milk			
	Laos-born	Thailand-born	FRG-born	TOTAL
Age at interview:	36-72 mos	14-69 mos	2-34 mos	2-72 mos
Breast milk only:	15 (45%)	8 (44%)	3 (6%)	26 (25%)
Formula milk** only:	3 (9%)	3 (17%)	20 (39%)	26 (25%)
Condensed milk+ only:	2 (6%)	0	0	2 (2%)
Breast milk and Formula milk:	5 (15%)	5 (28%)	28 (55%)	38 (37%)
Breast milk and Condensed milk:	6 (18%)	1 (6%)	0	7 (7%)
Formula milk and Condensed milk:	2 (6%)	1 (6%)	0	3 (3%)
Total	33 (100%)	18 (100%)	51 (100%)	102 (100%)

---

* Parentheses contain proportion of each milk category among the total sample in each birth group, in percent rounded to nearest whole number.

** Commercially-prepared infant formula.

\+ Commercially-available sweetened condensed milk.

Table 7. Distribution of DMFT of FRG-Laos and German* preschool chlidren, sex combined.

Age-group (months)	Number	FRG-Laos: Number of Total Teeth Mean (S.D.)	FRG-Laos: Number of DMFT Mean (S.D.)	Germans*: Number of DMFT Mean (S.D.)
2-12	10	2.3 (2.9)	0.4 (1.3)	n.a. n.a.
13-24	24	13.9 (4.9)	0.6 (1.9)	n.a. n.a.
25-36	21	18.7 (1.7)	4.6 (3.5)	1.1 (0.3)
37-48	16	20.5 (1.4)	6.3 (5.0)	1.5 (0.2)
49-60	19	20.7 (1.9)	12.6 (6.2)	2.0 (0.2)
61-72	12	21.3 (1.9)	9.6 (4.9)	2.6 (0.5)
Total	102			

* = German preschool children from Stormarn, Hamburg . (Gülzow, 1985)

Table 8.

Summary of Health, Social, and Economic Variables of Lowland Laotian Refugee Children, their Parents and Households in the Federal Republic of Germany (FRG), 1982

	Total Subjects or Respondents	Mean	(S.D.)	No. Reporting Variable	%
STUDY SUBJECT CHILDREN					
Birth Weight	90	3052 g	497 g	90	100%
Decayed, Missing, & Filled Teeth/Total Teeth	105	8	5.6	70	66.7%
Recent Symptoms*					
Cough	105			32	30%
Fever	105			18	17%
Diarrhea	104			4	4%
HOUSEHOLDS OF SUBJECTS					
Income per month	51	1,939 DM	1,278 DM		
Type					
Nuclear Family (husband, wife and their children)				53	73%
Extended Family (nuclear plus relatives)				15	21%
Family with Unrelated Persons				3	4%
sepeated Family				1	1%
do not know				1	1%
Total				73	100%
PARENTS OF SUBJECTS					RANGE
Father					
Age	65	32 y	7.7 y		22-69 y
Schooling in Laos	68	10 y	3.2 y		6-16 y
Mother					
Age	68	27 y	5.8 y		18-48 y
Schooling in Laos	71	7 y	3.5 y		0-14 y
Duration in Thailand	73	13 m	10.9 m		1-60 m
Duration in FRG	73	32 m	8.2 m		9-45 m

* Symptoms in child in week preceding examination, as reported by mother.
y year
m month

Table 9.

Reported Occupations of Mothers and Fathers of Lowland Laotian Refugee Children during Residence in Laos and Residence in Federal Republic of Germany.

Occupation	Mothers				Fathers			
	In Laos		In FRG		In Laos		In FRG	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Housewife	27	(37%)	51	(70%)	0	(0 %)	0	(0%)
Official	15	(21%)	0	(0%)	16	(22%)	0	(0%)
Student	11	(15%)	0	(0%)	7	(10%)	2	(3%)
Employee	6	(8%)	0	(0%)	11	(15%)	0	(0%)
Skilled Worker	4	(5%)	0	(0%)	25	(34%)	12	(16%)
Merchant	4	(5%)	0	(0%)	2	(3%)	0	(0%)
Farmer	2	(3%)	0	(0%)	3	(4%)	0	(0%)
Worker	2	(3%)	19	(26%)	2	(3%)	49	(67%)
Unemployed	0	(0%)	1	(1%)	1	(1%)	8	(11%)
Do not know	2	(3%)	2	(3%)	6	(8%)	2	(3%)
TOTAL	73	(100%)	73	(100%)	73	(100%)	73	(100%)

Table 10. Distribution of "correct" and "do not know" answers in each question.

Question no.	% correct answer	% do not know answer
1	8	5
2	9	12
3	7	17
4	7	10
5	2	0
6	47	8
7	38	53
8	50	18
9	86	10
10	39	3
11	13	13
12	85	10
13	10	13
14	82	13
15	2	68
16	2	2
17	12	35
18	59	3
19	97	3
20	2	48

8. BIBLIOGRAPHY

Abaheseen, 1981
Abaheseen MAA, Harrison GG, Pearson PB. Nutritional status of Saudi Arab preschool children in the eastern province. Ecol Food Nutr 1981;10(3):163-168.

Adams, 1970
Adams NS, McCoy AW. eds. War and revolution. New York, Evanston, London: Harper and Row, 1970.

Alleyne, 1977
Alleyne GAO, Hay RW, Picou DI, Stanfield JP, Whitehead RG. Protein-energy malnutrition. London: Edward Arnold, Ltd., 1977.

Anderson, 1979
Anderson MA. Comparison of anthropometric measures of nutritional status in preschool school children in five developing countries. Am J Clin Nutr 1979;32:2339-2345.

Ashcroft, 1964
Aschcroft TM, Lovell HG, Heights and weights of Jamaican children of various racial origins. Trop Geog Med 1964;16:346-353.

Ashcroft, 1976
Aschcroft TM, Desai P. Ethnic difference in growth potential children of African, Indian, Chinese and European origin. Trans Roy Soc Trop Med Hyg 1976;70:433-438.

Bairagi, 1980
Bairagi R. Is income the only constraint on child nutrition in rural Bangladesh? Bull World Health Org 1980;58:767-772.

Bastow, 1982
Bastow MD. Anthropometry revisited. Proc Nutr Soc 1982;41:381-388.

Baumgartnet RN, 1983
Baumgartnet RN, Pollitt E. The bacon chow study: analyses of the effects infectious illness on growth of infants. Nutr Res 1983;3(1):9-21.

Bergevin, 1983
Bergevin Y, Dougherty C, Kramer MS. Do infant formula samples shorten the duration of breast-feeding? Lancet 1983;21:1148-1151.

Boas, 1982
Boas F. Race, Language and Culture. 2nd ed. Chicago: University of Chicago Press, 1982.

Boonperm, 1984
Boonperm P, Schelp FP. Determinants of anthropometric measurements in a prosperous village in Northeast Thailand with a high prevalence of "wasted" children. Nutr Res 1984;4:591-600.

Bray, 1978
Bray AG, Greenway LF, Molitch EM, Dahms TW, Atkinson LR, Hamilton K. Use of anthropometric measures to assess weight loss. Am J Clin Nutr 1978;31:769-773.

Brooke,1973
Brooke OG, Harris M, Salvosa CB. The response of malnourished babies to cold. J physiol 1973;233:75-91.

Brozek, 1956
Brozek J. Physique and nutritional status of adult men. Human Biol 1956;28:124-140.

Brück,1978
Brück K. Heat production and temperature regulation. In: Stave U ed. Perinatal physiology. New York: Plenum Press, 1978.

Burgert, 1979
Burgert SL, Anderson CF. An evaluation of upper arm measurements used in nutritional assessment. Am J Clin Nutr 1979;32:2136-2142.

Cameron, 1978
Cameron N. The method of auxological anthropometry. In: Falkner F, Tanner JM, eds. Human growth. New York: Plenum Press, 1978;1:35-90.

CDC, 1979a
Center for Disease Control. Health status of Indochinese refugees. Morbidity and Mortality Weekly 1979;28:(33)385-398.

CDC, 1979b
Center for Disease Control. Health status of Indochinese refugees: malaria and hepatitis B. Morbidity and Mortality Weekly Report 1979;28(39): 463-470.

CDC, 1979c
Center for Disease Control. Diphtheria in Indochinese refugees from Thailand. Morbidity and Mortality Weekly Report 1979;28(43):509-520.

CDC, 1979d
Center for Diseaese Control. Health status of Kampuchean refugees - Sakaeo. Morbidity and Mortality Weekly Report 1979;28(46):545-546.

CDC, 1979e
Center for Disease Control. Health status of Kampuchean refugees - Khao-I-Dang. Morbidity and Mortality Weekly Report 1979;28(48):569-570.

CDC, 1980a
Center for Disease Control. Health screening of resettled Indo-chinese refugees - Washington, DC, Utah. Morbidity and Mortality Weekly Report 1980;29(1):4-11.

CDC, 1980b
Center for Disease Control. Nutritional status of Southeast Asian refugee children. Morbidity and Mortality Weekly Report 1980;29(39):477-480.

CDC, 1981
Centers for Disease Control. Tuberculosis among Indochinese refugees - an update. Morbidity and Mortality Weekly Report 1981;30(48):603-606.

Chang, 1963
Chang FSK, Lee MCM, Low WD, Kvan E. Height and weight of Southern Chinese children. Am J Phys Anthropol 1963;21:497-509.

Chavez, 1975
Chavez A, Martinez C, Bourges H. Role of lactation in the nutrition of low socioeconomic groups. Ecol Food Nutr 1975;4:159-169.

Chen, 1979
Chen LC, Chowdhury, AKMA, Huffman, SL. Seasonal dimensions of energy protein malnutrition in rural Bangladesh: the role of agriculture, dietary practices and infection. Ecol Food Nutr 1979,8:175-187.

Chen, 1981
Chen LC, Huq E, D'Souza S. Sex bias in the family allocation of food and health care in rural Bangladesh. Pop and Develop Rev 1981;7(1):55-70.

Clements, 1953
Clements BME. Changes in the mean stature and weight of British children over the past seventy years. Br Med J 1953;2:897-902.

Collis, 1962
Collis FRW, Dema I, Lesi FEA. Transverse survey of health and nutrition, Pankshari Division, Northern Nigeria. West Afr Med J 1962;11:131-154.

Cooper, 1982
Cooper A, Heird WC. Nutrition assessment of the pediatric patient including the low birthweight infant. A J Clin Nutr 1982;35:1132-1141.

Dawkins, 1965
Dawkins MJR, Scopes JW. Non shivering thermogenesis and brown adipose tissue in the human new born infant. Nature 1965;206:201-202.

Dugdale, 1970
Dugdale AE, Chen ST, Hewitt G. Patterns of growth and nutrition in childhood. Am J Clin Nutr 1970;23: 1280-1287.

Dugdale, 1979
Dugdale AE, Chandler D, Boghurst K. Knowledge and belief in nutrition. Am J Clin Nutr 1979;32: 441-445.

Egoramaiphol, 1980
Egoramaiphol S, Schelp FP, Pongpaew P, Migasena P, Harinasuta C, Saovakontha S. Anthropometric assessment of the nutritional status of children from birth to 60 months old from a water resource development area in Northeast Thailand - application of an international growth standard. J Med Assoc Thailand 1980;63(1): 15-24.

El-Mougi, 1981
El-Mougi M, Mostafa S, Osman NH, Ahmed KA. Social and medical factors affecting the duration of breast feeding in Egypt. J of Trop Pediatr 1981;27(1):5-11.

Erickson, 1980
Erickson RV, Ngoc Hoang G. Health problems among Indochinese refugees. Am J Public Health 1980;70(9):1003-1006.

Etta, 1979
Etta KM, Singh A. Towards the establishment of norms: 1. the triceps, subscapular skinfolds and subcutaneious fat in black and caucasian school children. Trop Pediat and Env Chld Hlth 1979;25:113-118.

Eusebio, 1981
Eusebio JS. Attainable growth. Lancet 1981;28:1223.

Feldmeier, 1981
Feldmeier H, Feldheim W, Rasp F, Bienzle U. Das Krankheitsspektrum von Flüchtlingen aus Südostasien. Deutsches Ärzteblatt-Ärztliche Mitteilungen. 1981;17:817-823.

Frisancho, 1974
Frisancho AR. Triceps skinfold and upper arm muscle size norms for assessment of nutritional status. Am J Clin Nutr 1974;27:1052-1058.

Frisancho, 1981
Frisancho AR. New norms of upper limb fat and muscle areas for assessment of nutritional status. Am J Clin Nutr 1981;34:2540-2545.

Frisancho, 1983
Frisancho AR. Maternal nutritional status and adolescent pregnancy outcome. Am J Clin Nutr 1983;38:739-746.

Frisancho, 1984
Frisancho AR, Matos J, Bollettino LA. Influence of growth status and placental function on birth weight of infants born to young-still growing teenagers. Am J Clin Nutr 1984;40:801-807.

Froelich JW, 1970
Froelich JW. Migration and the Plasticity of Physique in the Japenese Americans of Hawaii. Am J Phys Anthropol 1970;32:429-342.

Glasauer, 1982
Glasauer P, Leitzmann C. Studies on preschool children in northern Thailand. 2. The relationship between nutritional status and nutrition knowledge. Nutr Rep International 1982;25:363-371.

Goldstein, 1980
Goldstein H, Tanner JM. Ecological considerations in the creation and use of child growth standards. Lancet 1980;1:582-585.

Gomez, 1955
Gomez F, Galvan RR, Craviato J, Frenk S. Malnutrition in infancy and childhood with special reference to kwashiorkor. In: Levine S, ed. Advances in pediatrics. New York: Year Book Publishers, 1955.

Gomez, 1956
Gomez F, Galvan RR, Frenk S, Munoz JC, Chavez R, Vazquez J. Mortality in second and third degree malnutrition. J Trop Pediatr 1956;2:77-83.

Gormican, 1980
Gormican A, Valentine J, Satter E. Relationships of maternal weight gain, prepragnancy weight, and infant birthweight. J of the Am Dietet Assoc 1980;77:662-667.

Graitcer, 1981
Graitcer PL, Gentry E. Measuring children: one reference for all. Lancet 1981;2:297-299.

Gray, 1980
Gray GE. Anthropometric measurements and their interpretation: Principle Practice and Problems. J of

the Am Diet Assoc 1980;77:534-539.

Greulich, 1957
Greulich WW. A comparison of the physical growth and development of American born and native born Japanese children. Am J Phys Anthropol 1957;15:489-515.

Gueri, 1980
Gueri M, Gurney JM, Jutsum P. The Gomez classification, time for a change? Bull Wld Hlth Org 1980;58(5):773-777.

Gülzow, 1985
Gülzow HJ, Schiffner U, Bauch J. Milchzahnkariess bei Kindern aus Stormaner Kindergärten. Dtsch Zahnärztl Z 1985;40:1044-1048.

Habicht, 1974
Habicht JP, Martorell R, Yarbourgh C, Malina MR, Klein ER. Height and weight standards for preschool children. How relevent are ethnic differences in growth potential? Lancet 1974;1:611-614.

Haider, 1984
Haider M, Haider QS. Assessment of protein-calorie malnutrition. Clin Chem 1984;30(8):1286-1299.

Halpern, 1964a
Halpern JM. A study of tradition and innovation. In: Government, politics and social structure in Laos. Monograph Series no. 4, Southeast Asia Studies. New Haven: Yale University, 1964.

Halpern, 1964b
Halpern JM. Economy and society of Laos: A brief survey. In: Government, politics and social structure in Laos. Monograph Series no. 4, Southeast Asia Studies. New Haven: Yale University, 1964.

Hanafy, 1972
Hanafy MM, Seddich Y, Habib AY. Maternal nutrition and lactation performance. J Trop Pediatr Environ Child Health 1972;18:187-191.

Hathaway, 1957
Hathaway LM. Height and weight of children and youth in the United States. Home Economics Research no. 2. Washington, DC: United States Department of Agriculture, 1957.

Hey,1969
Hey EN, Katz G. Temperature loss of a metabolic response to cold stress in infants of low birthweight. Arch Dis Childh 1969;44:323-330.

Jellifee, 1966
Jelliffe DB. Assessment of nutritional status of the community. WHO Monograph no. 53. Geneva: World Health Organization, 1966.

Jelliffe, 1969
Jelliffe DB, Jelliffe EPP. The arm circumference as a public health index of protein calorie malnutrition of early childhood. J Trop Pediatr 1969;15:233-60.

Jenss, 1940
Jenss MR. Gain in weight and its association with ancestry and economic status. Human Biol 1940;12:532-544.

Jumsai, 1967
Jumsai M. History of Laos. Bangkok: Chalermnit, 1967.

Kagan, 1974
Kagen A, Harris BR, Winkelstein W, Johnson KG, Koto H, Syme SL, Rhoads GG, Gay ML, Nichamann MZ, Hamilton HB, Tillotston J. Epidemiologic studies of coronary heart disease and stroke in Japenese men living in Japan, Hawaii, and California: demographic, physical, dietary and biochemical characteristics. J Chron Dis 1974;27:345-364.

Kautz, 1981
Kautz L, Harrison GG. Comparison of body proportions of one-year-old Mexican-American and anglo children. Am J Public Health 1981;71(3):280-282.

Keller W, 1976
Keller W, Donoso G, DeMaeyer EM. Anthropometry in nutritional surveillance: a review based on results of the WHO collaborative study on nutritional anthropometry. Nutr Abs Rev 1976;46(8):591-606.

Keys, 1973
Keys A, Grande F. Body weight, body composition and calorie status. In: Goodhart RS, Shils ME, eds., Modern nutrition in health and disease. 5th ed. Philadelphia: Lea & Febiger, 1973.

Lasker, 1946
Lasker GW. Migration and physical differentiation. Am J Phys Anthropol 1946;4:273-300.

Lauber, 1981
Lauber E, Reinhard MC. Prolonged lactation performance in a rural community of the Ivory Coast. J of Trop Pediatr 1981;27(2):74-77.

Lavoipierre, 1983
Lavoipierre GJ, Keller W, Dixon H, Dustin J-P, ten Dam G. Measuring change in nutritional status. Geneva:

World Health Organization, 1983.

Lebar, 1960
Lebar FM, Suddard A. eds. Laos: its people, its society, its culture. New Haven: Human Relations Area File Press, 1960.

Levinson, 1974
Levinson FJ. Mounda: An economic analysis of malnutrition among young children in Rural India. Cornell - MIT International Nutrition Policy Series. Cambridge, Mass, USA, 1974.

Lindberg,1970
Lindberg O. ed. Brown adipose tissue. New York: Elsevier, 1970.

Martorell, 1976
Martorell R, Yarbrough C, Lechtig A, Delgado H, Klein ER. Upper arm anthropometric indicators of nutritional status. Am J Clin Nutr 1976;29:46-53.

Mata, 1977
Mata LJ, Kromal RA, Urrutia JJ, Garcia B. Effect of infection on food intake and nutritional state: perspectives as viewed from the village. Am J Clin Nutr 1977;30(8):1215-1227.

Nabarro, 1984
Nabarro D. Social, economic health and environmental determinants of nutritional status. Food and Nutr Bull 1984;6(1):18-32.

National Geographic Society, 1971
National Geographic Society. The peoples of mainland Southeast Asia (map). Washington DC, 1971.

NCHS, 1976
National Center for Health Statistics. NCHS Growth charts. Health Resources Administration, Public Health Service, US Department of Health, Education, and Welfare, Rockville, Maryland. 1976. Publication HRA 76-1120, 25-33.

Nie, 1975
Nie NH, Hull CN, Jenkins JG, Steinbrenner K, Bent DH. SPSS: statistical package for the social sciences. 2nd ed. New York: McGraw Hill Book Company, 1975.

Niemitz, 1984
Niemitz C, Klauer G, Eins S. The interscapular brown fat body in Tarsius bancanus, with comparisons to Tupaia and man. In: Niemitz C, ed. Biology of Tarsius. New York, Stuttgart: Fischer. 1984:257-273.

Ojaba, 1985
Ojaba E, Ostrowski ZL. Seasonality of nutrition on growth in the second year of life in Sudan. 13th International congress of nutrition, Brighton, UK. Abstract no. 0124.

Olness, 1984
Olness K, Yip R, Indritz A, Torjesen E. Height and weight status of Indochinese refugee children. Am J Dis Child 1984;138:544-547.

O'Sullivan, 1980
O'Sullivan G, Ebrahim S, O'Sullivan J, Tafts C. Nutritional status of Laotian refugee children in Ubol camp, Thailand. J of Epidemiol and Community Health 1980;34:83-86.

Patton, 1963
Patton RG, Gardner LI. Growth failure in maternal deprivation (a collection of case histories and discussion). Springfield, Illinois (USA): Thomas Co., 1963.

Peck, 1981
Peck RE, Chuang M, Robbins GE, Nichaman MZ. Nutritional status of Southeast Asian refugee children. Am J Public Health 1981;71(10):1144-1148.

Prema, 1982
Prema K, Ravindranath M. The effect of breast feeding supplements on the return of fertility. Studies in Family Planning 1982;13(19):293-296.

Rao, 1976
Rao DH, Stayanarayana K, Sastry JG. Growth pattern of well-to-do Hyderabad preschool children. Indian J Med Res 1976 ;64:629-638.

Ratnam, 1982
Ratnam P. Laos and its culture. New Delhi: Tulsi Publishing House, Karol Bagn, 1982.

Rea, 1971
Rea JN. Social and economic influences on the growth of preschool children in Lagos. Human Biol 1971;43:46-63.

Reinken, 1980a
Reinken L, Stolley H, Droese W, Van Oost G. Longitudinale Koerperentwicklung gesunder Kinder. 2. Groesse, Gewicht, Hautfettfalten von Kindern in Alter von 1.5 bis 16 Jahren. Klin Paediat (Fed Rep Germany) 1980;192:25-33.

Reinken, 1980b
Reinken L, Stolley H, Droese W, Van Oost G. Longitudinale Koerperentwicklung gesunder Kinder. 3. Brust-, Oberarm-, Oberschenkel und Wandeumfang von Kindern im Alter von 2.0 bis 15 Jahren. Klin Paediat (Fed Rep Germany) 1980;192:34-38.

Roberts, 1966
Roberts TD, Carroll ME, Kaplan I, Matthews JM, McMorris DS, Townsend C. Area handbook for Laos. Washington, DC: U.S. Government Printing Office, 1966.

Robson, 1971
Robson JRK, Bazin M, Soderstrom R. Ethnic diffences in skinfold thickness. Am J Clin Nutr 1971;24:864-868.

Rowland, 1977
Rowland MGM et al. A quantitative study into the role of infection in determining nutritional status of Gambian village children. Br J Nutr 1977;37:441-450.

Schelp, 1982
Schelp FP, Sornmani S, Egoramaiphol S, Pongpaew P, Keller W, Harinasuta C, Migasena P. Physical growth of preschool children in relation to a water resource delevelopment scheme in Thailand. J Trop Ped 1982;28:187-192.

Shakir, 1974
Shakir A, Morley D. Measures of malnutrition. Lancet 1974;(i):758-759.

Statistisches Bundesamt
Statistisches Bundesamt Bevölkerung und Erwerbstätigkeit Reihe 2, Ausländer 23, 1983.

Stuart, 1959
Stuart HC, Stevenson SS. Physical growth and development. In: Nelson W, ed. Textbook of pediatrics, 7th ed. Philadelphia: Saunders, 1959:12-61

Tanner, 1962
Tanner JM, Whitehouse RH. Standards for subcutaneous fat in British children. Br Med J 1962;17:446-450.

Tanner, 1966
Tanner JM, Whitehouse RH, Takaishi M, Standard from birth to maturity for height, weight, height velocity and weight velocity: British children I. Arch Dis Child 1966;41:454-471.

Tanner, 1976
Tanner JM. Population differences in body size, shape and growth rate. Arch Dis Child 1976;51:1-2.

Tontisirin, 1983
Tontisirin K. Present status of breast feeding in Thailand. J Med Assoc Thailand 1983;66(8):488-491.

Taylor, 1978
Taylor CA, Emanuel L, Morris LN, Prosterman RL. Child nutrition and mortality in the rural Philippines. Is socio-economic status important? J Trop Pediatr Env Child Health 1978;24:80-86.

The Times, 1983
The Times atlas of the world. New York: Times Books, 1983.

Topp, 1970
Topp SG, Cook J, Holland WW. Influence of environmental factors on height and weight of school children. Brit J Prev Social Med 1970;24:154-162.

Toye, 1968
Toye H. Laos buffer state or battle ground. London: Oxford university press, 1968.

Trowbridge, 1979a
Trowbridge FL. Clinical and biochemical characteristics associated with anthropometric nutritional categories. Am J Clin Nutr 1979;32:758-766.

Trowbridge, 1979b
Trowbridge FL, Newton LH. Seasonal changes in malnutrition and diarrhoeal disease among preschool children in EL Salvador. Am J of Trop Med Hyg 1979;28:135-141.

Trowbridge, 1980
Trowbridge FL, Staehling N. Sensitivity and specificity of arm circumference indicators in identifying malnourished children. Am J Clin Nutr 1980;33:687-696.

Udani, 1963
Udani PM. Physical growth in children in different socio-economic groups. Indian J Child Health 1963;12:593-611.

UNHCR, 1981
United Nations High Commissioner for Refugees (Thailand). Annual summary of medical and public health reports from Indochinese refugee camps and holding centers in Thailand, December 1980 to November 1981. [Prepared for UNHCR by the Catholic Office for Emergency Relief and Refugees, Bangkok, Thailand]

UNHCR, 1983
United Nations High Commissioner for Refugees, Indochinese Refugees: Laotians. Refugees 1983;(3):15-16.

UNHCR, 1984
United Nations High Commissioner for Refugees (Thailand). Medical and public health report, UNHCR-assisted refugee camps in Thailand, annual summary 1984. [Prepared for UNHCR by the Catholic Office for Emergency Relief and Refugees, Bangkok, Thailand]

UNHCR, 1985
United Nations High Commissioner for Refugees, Thailand. Refugees and displaced person from Indochina in UNHCR-assisted camps in Thailand. Bangkok, 1985.

Vichairaghaven, 1971
Vichairaghaven K, Singh D, Swaminathan MC. Heights and weights of well-nourished Indian schoolgoing children. Indian J Med Res 1971;59:648-654.

Vichairaghaven, 1974
Vichairaghaven K, Shastry JG, Jindal IB. Growth performance of well-to-do Hyderabad children: a follow-up study. Indian J Med Res 1974;62:117-124.

Victora, 1984
Victora CG, Vaughan JP, Martines JC, Barcelos LB. Is prolonged breast-feeding associated with malnutrition? Am J Clin Nutr 1984;39(2):307-314.

Waterlow, 1972
Waterlow JC. Classification and definition of protein-calorie-malnutrition. Br Med J 1972;3:566-569.

Waterlow, 1973
Waterlow JC. Note on the assessment and classification of protein energy malnutrition in children. Lancet 1973;1:87-89.

Waterlow, 1977
Waterlow JC, Buzina R, Keller W, Lame JM, Nichaman MZ, Tanner JM. The presentation and use of height and weight data for comparing the nutritional status of groups of children under the age of 10 years. Bulletin of the World Health Organization 1977;55:489-498.

Waterlow, 1978
Waterlow JC. Observations on the Assessment of Protein-Energy Malnutrition with Special Reference to Stunting. Courier 1978;28(5):455-460.

Waterlow, 1979
Waterlow JC, Thomson AM. Observations on the adequacy of breast-feeding. Lancet 1979;4:238-241.

Wellcome, 1970
Anonymous. Classification and definition of protein-calorie malnutrition. Lancet 1970;2:302-303.

WHO, 1983
World Health Organization. Measuring change in nutritional status. Geneva: World Health Organization, 1983.

WHO, 1986
World Health Organization. The global oral epidemiology bank of the World Health Organization. Geneva, 1986.

Wilmsen, 1978
Wilmsen EN. Seasonal effect of dietary intake in the Kalahari. San Fed Proc 1978:37(1):65-78.

Zerfas, 1977
Zerfas AF, Shorr IJ, Neumann CG. Office Assessment of Nutritional Status. Pediatric Clinics of North America, 1977;24(1):253-272.

9. ACKNOWLEDGEMENT

We are grateful to Dr. Sittichai Egoramaiphol and Somsak Toprasert for assistance in surveying the Thailand refugee camps; to Dr. Dankmar Boehning for computer analysis; to Axel Hempfling for graphic design; to Hans Schirrmeister for providing computer facility; to Dr. Bruce G. Weniger for editorial review; to the Inthalaksa family and to Tong Khoungkhakoune, Vongsawan Panmanivoung, and Vahn Prakosay for help in contacting the families of study subjects; to the Laotian community in the FRG for their interest and cooperation; and to Professor C. Niemitz for his interest, supervision, and guidance.

The author is deeply indebted to Professor F.P. Schelp, who has generously given his time, support and advice in the preparation of this dissertation.

10. APPENDICES

I - Health Knowlege Survey Form (in Lao)

II - Health Knowledge Survey Form (English translation)

III - Curriculum Vitae

APPENDIX I

HEALTH KNOWLEDGE SURVEY QUESTIONS
(in Lao)

ແບບສອບຖາມກ່ຽວກັບຄວາມຮູ້ ແລະ ຄວາມເຂົ້າໃຈກ່ຽວກັບສຸຂະພາບ ແລະ ອາຫານການກິນຢູ່ຂອງ ແມ່ແລະເດັກ

ຄຳຖາມທັງຫມົດມີ ๘๐ ຄຳຖາມ

ຄຳຕອບຂອງແຕ່ລະຄຳມີ ๓ (ສາມ)ສິນຄ໌ :
๑- ແມ່ນ
๒- ບໍ່ແມ່ນ
๓- ບໍ່ຮູ້

ຂໍ້ຄວາມກະລຸນາຕອບທຸກໆຄຳຖາມ(ແຕ່ລະຄຳຖາມຕອບໄດ້ສະເພາະຄຳຕອບດຽວເທົ່ານັ້ນ)

ຄວາມຮູ້ແລະຄວາມເຂົ້າໃຈໃນການກິນຢູ່

ค ำ ถ า ม	: แม่น	: บ่แม่น	: บ่ รู้ :
๑- ຕ່ອນເຖົ້າເຈົ້າຄວນກ້ວງຄະລ່ຳກ່ຽວກັບອາຫານການກິນແມ່ນບໍ?.....	:____:	_____:	____:
๒- ການສັກຢາປ້ອງກັນໂຣຄ ໃຫ້ແກ່ເດັກນ້ອຍໄດ້ພຽງແຕ່ຍົກດຽວ(ຕົວຢ່າງກັບໂຣຄປ້ອງກັນ ປອດແຫ້ງ,ຄໍຕັບ,ຂີ້ຮ້ອຍ ແລະອື່ນໆ)ຈະປ້ອງກັນໃຫ້ເດັກນ້ອຍນັ້ນເຈັບປ່ວຍໄປໄດ້ແມ່ນບໍ	:____:	_____:	____:
๓- ແມ່ນຍູ້ກລຍາສນິດຈະເຂົ້າໃນຕົວຂອງພວກທ່ານໄດ້ໃນທາງປາກ ແລະ ຜິວໜັງໄດ້ ແມ່ນບໍ ?.....	:____:	_____:	____:
๔- ຍາມເດັກນ້ອຍຕ້ອງເສັ້ນຄວນໃຫ້ເຂົ້າຄີ້ນໜ້າແມ່ນບໍ ?.....	:____:	_____:	____:
๕- ການກິນຢາວິຕາມິນ บี- ก้ำมปลกส(B-Complex)ເປັນປະຈຳຈະຫ່ຳໃຫ້ ຮ່າງກາຍມີກຳລັງແຂ็ງແຮງແມ່ນບໍ?.....	:____:	_____:	____:
๖- ອົນຫວານ ແລະຂອງຫວານອື່ນໆ ເປັນສາຍເຫດນຶ່ງທີ່ພາໃຫ້ແຂ้ອຂອງເດັກນ້ອຍເສັ້ນ (ເປັນແນ) ໄດ້ແມ່ນບໍ ?.....	:____:	_____:	____:
๗- ນ้ຳເຜົ້ງຈະໃຫ້ປະໂຍກ(ພລັງງານ)ແກ່ຮ່າງກາຍຂອງເຮົາຫລາຍກວ່ານ้ຳຕານແມ่นบໍ ?	:____:	_____:	____:
๘- ນົມແມ้ງົວຈາກຂວດກລຸກເລືອພາຍໃນນຶ່ງເດືອນຫາສອງເດືອນ ມີສິ่งใดสิ่งนึ่ง(ผูมต้าน ทานจุลโรค)ເປັນສິ่งที่จะต้านทานจุลโรคให้แก่เด็กน้อยได้แม่นบ่ ?.....	:____:	_____:	____:
๙- ນ้ຳຈາຈະໃຫ้ปะโยก (ผลังงาน)แก่ร่างกายของเจ้าฯกว่าภาคแม่นบ่?..	:____:	_____:	____:
๑๐-ภาบกินผัก,หมากไม้ ແລะอาหานหากพืช(ตัวอย่าง ถั่ว,ถั่วสาลิ, มัน, ผ้อก,และอื่นๆเป็นต้น)จะพาให้ย้อยถ่ากสดอกข้นแม่นบ่ ?.....	:____:	_____:	____:
๑๑-ถ้าเจ้ากินไขมันจะสองตบ่อย หากมันจะพาให้ละดับไขมันในเลือดของเจ้าเพิ่ม ขึ้นสองเท่าแม่นบ่?	:____:	_____:	____:
๑๒-น้ำมันพืดมีไขมันบ่ก่อานน้ำมันสัตแม่นบ่?	:____:	_____:	____:
๑๓-ภาบกินบน้ำตานทาย จะพาให้เจ้าเป็นพยากเบาหวาน(ๆอ่ยหวาน)ได้แม่นบ่?:	:____:	_____:	____:
๑๔-ข้าวบ่จะให้ปะโยก(ผลังงาน)แก่ร่างกายของเจ้าหากกว่าข้นมปังแม่นบ่?...	:____:	_____:	____:
๑๕-ภิมหุ้นหวานให้ฟันผุหากได้แม่นบ่ ?.....	:____:	_____:	____:
๑๖-อาหานสีดีกว่า อาหานแจ่แอว เผาะจ่าให้พลังงาน แก่ร่างกายเจ้าหาก กว่าแม่นบ่ ?.....	:____:	_____:	____:
๑๗-ใบหานลีดบ่หนัก มันบ่อ้นกับก่าบกินไขมัน น้ำมันหมูว่าหลาย มันอ้นปูหัว่า สนิดไขมันที่เจ้ากินแม่นบ่?.....	:____:	_____:	____:
๑๘-ภาบสูยยาเป็นสิ่งนึ่งที่พาให้เป็นโรคมะเรง,ปอดแห้ง ແລะ ไขมันตัน ให้เส้นเลือดได้แม่นบ่?.....	:____:	_____:	____:
๑๙-ภาบกินเก้าหลาย จะพาให้เป็นพยากดับสัตได้แม่นบ่?.....	:____:	_____:	____:
๒๐-ภาบกินเกือหลายจะพาให้ดอานดับเลือดสูงแม่นบ่?.....	:____:	_____:	____:

APPENDIX II

HEALTH KNOWLEDGE SURVEY QUESTIONS
(English translation)*

Food & Nutrition

1. Is honey nutritionally better than sugar? (no)
2. Is tea nutritionally better than coffee? (no)
3. Are vegetable oils less fattening than animal fat? (no)
4. Is meat nutritionally better than pork? (no)
5. Is fresh food nutritionally better than frozen food? (no)

Maternal & Child Care

6. Should certain foods be avoided during pregnancy? (no)
7. Does breast milk in the first two months of life provide some protection against infection for infants? (yes)
8. Is one vaccination shot for tuberculosis, tetanus, and polio enough to protect against these diseases? (no)
9. Should you give tea to your children when they have diarrhea? (yes)
10. Do sweets and candy cause dental caries in children? (yes)
11. Should sweeet condensed milk be used to feed infants? (no)

Health

12. Can some parasites enter the body through the skin? (yes)
13. Does taking vitamin-B complex pills regularly make you stronger? (no)
14. Does eating vegetables and fruits help to relieve constipation? (yes)
15. Does eating two eggs a day double blood cholesterol levels? (no)
16. Does eating a lot of sugar cause diabetes? (no)
17. In dieting, is the type of fat eaten more important than the amount? (no
18. Can smoking cause cancer? (yes)
19. Can drinking a lot of alcohol cause liver disease? (yes)
20. Can eating a lot of salt cause high blood pressure? (yes)

* answers considered "correct" in parentheses.

APPENDIX III

CURRICULUM VITAE

PAUNGTHIP BOONPERM

BIRTH:	13 March 1949 Kalasin, Thailand Thai citizen
LANGUAGES:	Thai: mother tongue Lao: fluent English: fluent German: fluent
EDUCATION:	
1983 - present	Institute for Anthropology and Human Biology and the department of Epidemiology Institute for Social Medicine Free University of Berlin Federal Republic of Germany (PhD candidate)
1981 - 1983	Institute for Nutritional Science Kiel University, Kiel Federal Republic of Germany (PhD study)
1981	Goethe Institute Prien am Chiemsee (German language study) Federal Republic of Germany
1975 - 1978	M.App.Sc. School of Food Technology University of New South Wales Sydney, Australia
1968 - 1972	B.Sc. Faculty of Science Chiang Mai University Chiang Mai, Thailand

EXPERIENCE:

1978 - 1981	Faculty Researcher
1973 - 1975	Department of Nutrition and Food Science Faculty of Tropical Medicine Mahidol University Bangkok, Thailand

PUBLICATIONS:

1. Schelp FP, Migasena P, Vudhivai N, BOONPERM P, Supawan V, Pongpaew P, Harinasuta C, Intraprasert R, Tharakul C. Alterations of human serum proteins and other biochemical parameters after five to ten days of untreated acute falciparum malaria. Tropenmed Parasitol 1977;28:291-408.

2. Migasena P, Schelp FP, Vudhivai N, BOONPERM P, Supawan V, Pongpaew P, Harinasuta C, Intraprasert R, Tharakul C. Serum protein fractions in acute falciparum malaria obtained by polyacrylamide gel electrophoresis. Ann Trop Med Parasitol 1978;72:3-12.

3. Pongpaew P, Saovakontha S, Schelp FP, Supawan V, Hongtong K, BOONPERM P. Serum lipid pattern in urban and rural Thai population. J Nutr Sci Vitaminol 1978;24:289-296.

4. BOONPERM P, Schelp FP. Determinants of anthropometric measurements in a prosperous village in Northeast Thailand with a high prevalence of "wasted" children. Nutr Res 1984;4:591-600.

PRESENTATIONS:

1. BOONPERM P. Adjustment of feeding patterns. Paper presented at the Xth Scientific Meeting of the International Epidemiological Association, Vancouver, Canada, August 19 - 25, 1984: abstract no. 210.